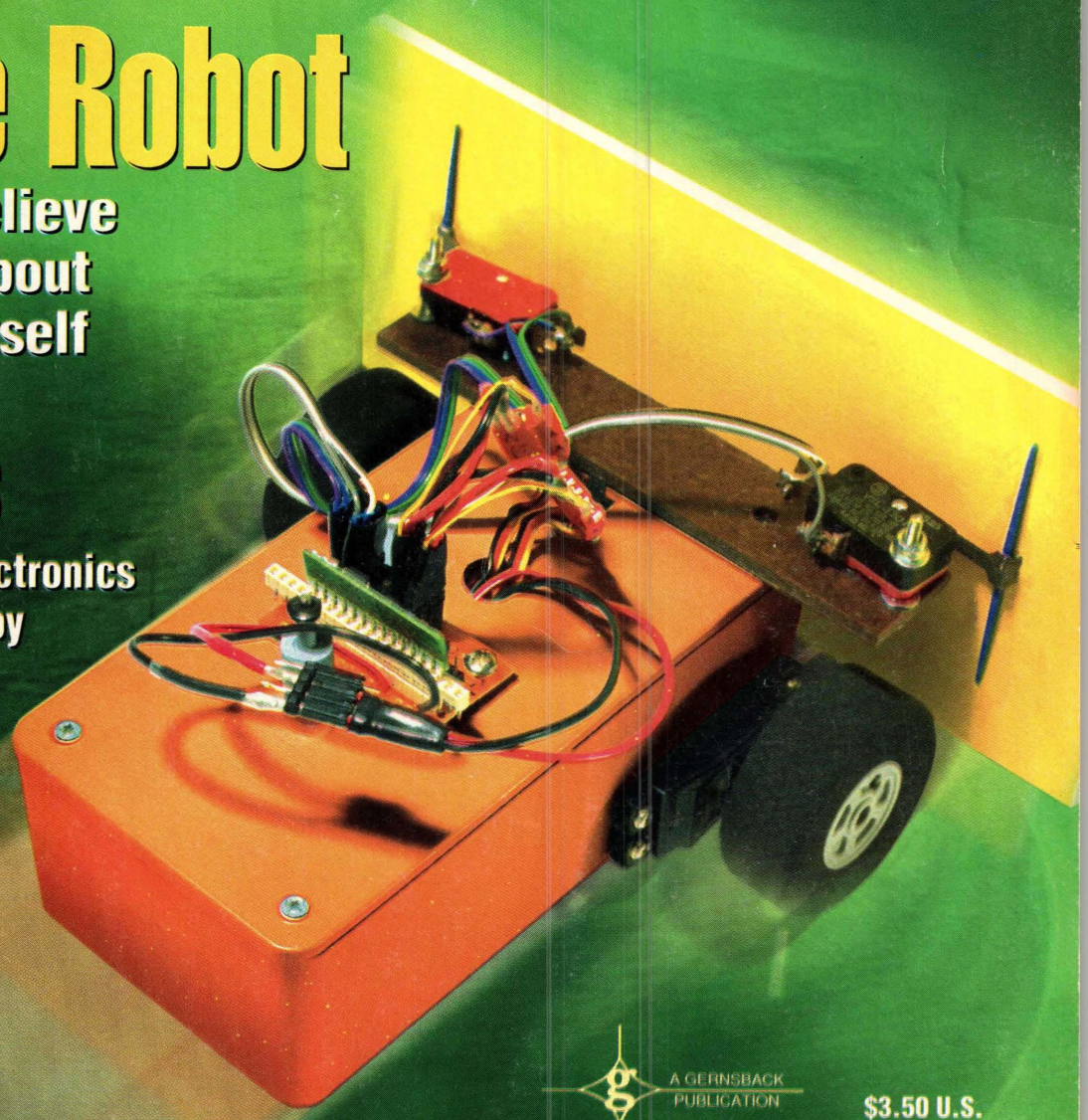
BUILD YOUR OWN MOBILE ROBOT

Popular Electronics®

September 1996

Build a Mobile Robot

You'll really believe this little runabout can think for itself



Toy Trains

See how today's electronics have made this hobby better than ever

All About Reflector Antennas

Greatly improve VHF/UHF reception

Build the Unlock-Too

With it, unlocking vehicle doors is as simple as turning off the ignition

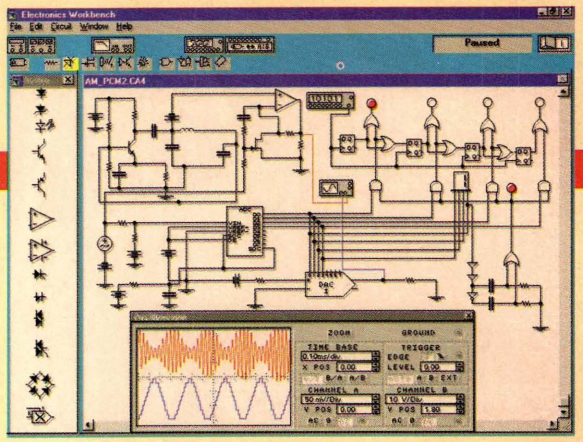
A GERNSBACK PUBLICATION

$3.50 U.S.
$3.95 CAN.

#BXBDCCH******** 3-DIGIT 522
#52233SEC395R1000# JAN97 S41

SPECIALIZED SYSTEMS INC RESP
R TIMM 130
PO BOX 395
HIAWATHA IA 52233-0395

Better Designs -Faster



Guaranteed with Electronics Workbench!

Just click and drag to create and edit schematics. Mix analog and digital devices in any combination with full control over values, models and behavior. Try 'what if' scenarios and fine tune effortlessly. And on-screen waveforms always match actual circuit response. You'll create better designs faster—*Guaranteed!*

Guaranteed Satisfaction

Join over 70,000 customers and experience the power, flexibility and value that only Electronics Workbench offers. Receive unequaled service and free, unlimited technical support by phone, fax, e-mail, WWW, CompuServe and BBS. You'll be delighted. *We guarantee it.**

True Mixed-Mode Power

Connect any analog or digital device to any other device without limit. Only Electronics Workbench offers this professional power for under $2,000.

Real-World Digital

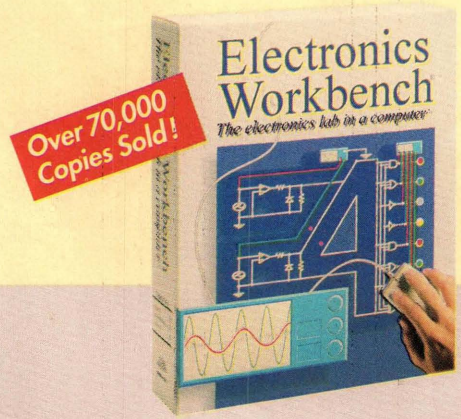
Real-world TTL and CMOS, complete with propagation delays and fanout. Unique at this price.

32-Bit Speed

Integrated SPICE analog and native-mode digital simulation in full 32-bit. Unique at this price.

Real-World Results

Unlimited supply of over 200 components and ICs and 350 real-world models—all perform as real devices.



Electronics Workbench®

$299

***30-DAY MONEY-BACK GUARANTEE**

VERSION 4.1 FOR WINDOWS 95/NT/3.1, DOS AND MACINTOSH.

Ask about our Engineer's Pack with thousands of additional models and more. Version 4.0 users call for your free upgrade.

800-263-5552 INTERACTIVE

Fax: 416-977-1818 Internet: http://www.interactiv.com

CompuServe: 71333,3435/BBS: 416-977-3540/E-mail: ewb@interactiv.com

INTERACTIVE IMAGE TECHNOLOGIES LTD., 908 Niagara Falls Boulevard, #068, North Tonawanda, New York 14120-2060/Telephone 416-977-5550

TRADEMARKS ARE PROPERTY OF THEIR RESPECTIVE HOLDERS. OFFER IS IN U.S. DOLLARS AND VALID ONLY IN THE UNITED STATES AND CANADA. ALL ORDERS SUBJECT TO $15 SHIPPING AND HANDLING CHARGE

Australia: 2-519-3933 • Belgium: 2-384-73-09 • Brazil: 11-453-5588 • Canada: 416-977-5550 • Chile: 2-236-0300 • Cyprus: 9-641-801 • Czech Republic: 4-823-454 • Denmark: 33-25-0109 • Finland: 0-297-5033 France: 1-49-08-90-00 • Germany: 711-62-7740 • Greece: 1-524-9981 • Hungary: 1-215-0082 • India: 11-578-7055 • Indonesia: 21-470-0815 • Israel: 3-647-5613 • Italy: 11-437-5549 • Japan: 3-5395-2126 Malaysia: 3-774-2189 • Mexico: 5-593-5260 • Netherlands: 10-450-4949 • New Zealand: 9-267-1756 • Norway: 22-16-70-45 • Philippines: 973-27-0118 • Portugal: 1-814-6609 • Singapore: 777-2303 • Slovenia: 61-317-830 South Africa: 331-6-8309 • South Korea: 2-3452-9757 • Spain: 1-383-8335 • Sweden: 8-740-5500 • Taiwan: 2-366-0080 • Thailand: 2-398-6952 • UAE: 4-453505 • UK: 203-23-3216 • USA: 416-977-5550

CIRCLE 13 ON FREE INFORMATION CARD

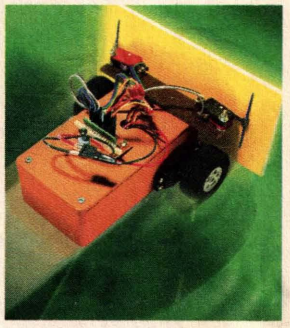
Popular Electronics®

SEPTEMBER 1996
Vol. 13, No. 9

A GERNSBACK PUBLICATION

COVER STORY

29 Build a Mobile Robot
This fully programmable robot will have you believing in artificial intelligence in no time. It can move around your house without ever getting stuck in a corner, and could be modified to imitate many other types of thought—*Mike O'Connor*

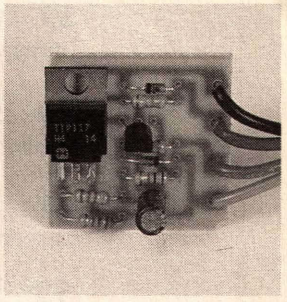


Page **29**

CONSTRUCTION

39 Build the Unlock-Too
If your vehicle has doors that automatically lock when you turn on the ignition, this circuit will save you the trouble of having to manually unlock them when you turn the ignition off—*Josh Friedman*

51 Build a Solid-State Stroboscope
With this precision handheld unit you can make remote RPM measurements, view rotating devices in stop-action, and take some impressive photos of moving objects. Best of all, it costs much less than commercial units—*Skip Campisi*



Page **39**

FEATURES

41 All About Reflector Antennas
Want a way to get better performance from your VHF/UHF radio gear without spending a lot of money? Try these low-cost, easy-to-build antenna designs; with them, you'll see and hear results immediately—*Joseph J. Carr*

45 Toy Trains
Modern electronics have made this hobby more enjoyable than ever. Here's a look at toy trains of the past and present, and at what you can do to get started with your own setup—*Dennis Eichenberg*

Page **45**

POPULAR ELECTRONICS (ISSN 1042-170-X) Published monthly by Gernsback Publications, Inc. 500 Bi-County Boulevard, Farmingdale, NY 11735. Second-Class postage paid at Farmingdale, NY and at additional mailing offices. One-year, twelve issues, subscription rate U.S. and possessions $21.95, Canada $28.84 (includes G.S.T. Canadian Goods and Services Tax Registration No. R125166280), all other countries $29.45. Subscription orders payable in U.S. funds only, International Postal Money Order or check drawn on a U.S. bank. U.S. single copy price $3.50.

Copyright 1996 by Gernsback Publications, Inc. All rights reserved. Hands-on Electronics and Gizmo trademarks are registered in U.S. and Canada by Gernsback Publications, Inc. Popular Electronics trademark is registered in U.S. and Canada by Electronics Technology Today, Inc. and is licensed to Gernsback Publications, Inc. Printed in U.S.A.

Postmaster: Please send address changes to Popular Electronics, Subscription Dept., P.O. Box 338, Mount Morris, IL 61054-9932

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

As a service to readers, Popular Electronics publishes available plans or information relating to newsworthy products, techniques, and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, Popular Electronics disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

SEPTEMBER 1996

PRODUCT REVIEWS

19 Gizmo
The Personal Computer (yesterday, today, and tomorrow), Compaq Presario 9240, Packard Bell Platinum Pro Multimedia PC Package, Brother MFC-4500 Multi-Function Center, and much more.

COLUMNS

8 Net Watch
Finding electronics on the Web—*Dan Karagiannis*

14 Multimedia Watch
WinHEC '96 and great software for kids—*Marc Spiwak*

57 Circuit Circus
Timing is everything—*Charles D. Rakes*

59 Scanner Scene
Monitoring Mickey Mouse—*Marc Saxon*

61 DX Listening
Exploring the information highway—*Don Jensen*

63 Ham Radio
Antenna topics—*Joseph J. Carr*

66 Think Tank
Looking back—*John Yacono*

70 Computer Bits
Help!—*Jeff Holtzman*

72 Antique Radio
A new restoration—*Marc Ellis*

DEPARTMENTS

4 Editorial

6 Letters

12 New Products

75 Electronics Library

79 Popular Electronics Market Center

114 Advertiser's Index

114A Free Information Card

Popular Electronics

Larry Steckler, EHF, CET, editor-in-chief and publisher

EDITORIAL DEPARTMENT
Dan Karagiannis, managing editor
Teri Scaduto, assistant editor
Evelyn Rose, editorial assistant
Joseph J. Carr, K4IPV, contributing editor
Marc Ellis, contributing editor
Jeffrey K. Holtzman, contributing editor
Don Jensen, contributing editor
Charles D. Rakes, contributing editor
Marc Saxon, contributing editor
Marc Spiwak, contributing editor
John Yacono, contributing editor

PRODUCTION DEPARTMENT
Ruby M. Yee, production director
Kathy Campbell, production assistant

ART DEPARTMENT
Andre Duzant, art director
Russell C. Truelson, illustrator

CIRCULATION DEPARTMENT
Jacqueline P. Cheeseboro, circulation director
Theresa Lombardo, circulation assistant

Michele Torrillo, POPULAR ELECTRONICS bookstore

BUSINESS AND EDITORIAL OFFICES
Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735
1-516-293-3000
FAX: 1-516-293-3115
President: **Larry Steckler**

SUBSCRIPTION CUSTOMER SERVICE/ ORDER ENTRY
1-800-827-0383
7:30 AM - 8:30 PM EST

Advertising Sales Offices listed on page 110

Composition by Mates Graphics

Cover by Loewy Design
Cover Illustration by Chris Gould

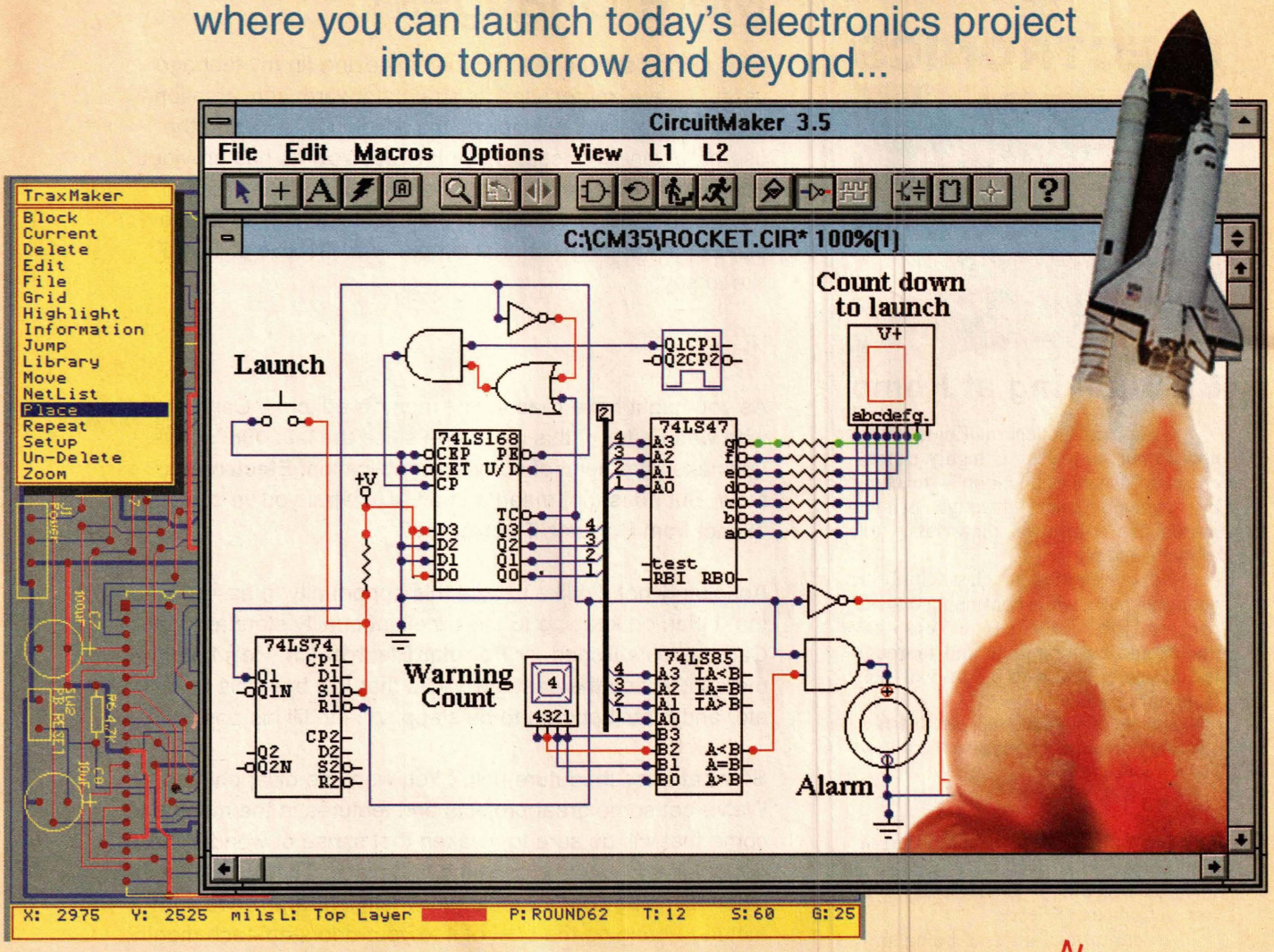
ABC AUDITED

Since some of the equipment and circuitry described in POPULAR ELECTRONICS may relate to or be covered by U.S. patents, POPULAR ELECTRONICS disclaims any liability for the infringement of such patents by the making, using, or selling of such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

CircuitMaker®

The Virtual Electronics Lab™

where you can launch today's electronics project
into tomorrow and beyond...



TraxMaker™

New Product

- DOS version only $299
- 30 day satisfaction guarantee
- user definable "Design Rules"
- imports CircuitMaker PCB netlist
- automatic or manual routing of tracks
- 8 layer, 32" x 32" maximum board size
- automatic or manual component placement

CircuitMaker®

New Windows 95/NT/3.1x Versions

- still only $299
- PCB netlist export
- includes 1500+ devices
- SPICE netlist import/export
- 30 day satisfaction guarantee
- professional schematic features
- digital, analog and mixed-mode simulation

Call now to order your complete circuit design system or request additional information:

800-419-4242

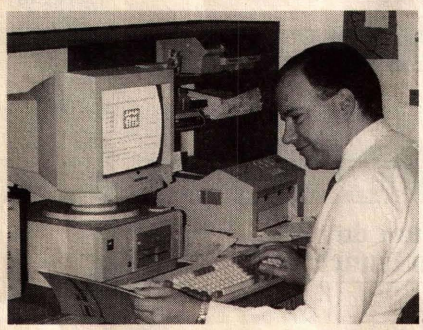
MicroCode Engineering
573 W. 1830 N. Suite 4
Orem, UT 84057 USA
Phone (801) 226-4470
FAX (801) 226-6532

FREE ON-LINE DEMO:
AOL; file search, CircuitMaker
CompuServe; GO MICROCODE
Internet; http://www.microcode.com

All trademarks are the property of their owners.

CIRCLE 157 ON FREE INFORMATION CARD

EARN YOUR
B.S. DEGREE
IN
COMPUTERS
OR
ELECTRONICS



By Studying at Home

Grantham College of Engineering, now in our 46th year, is highly experienced in "distance education"—teaching by correspondence—through printed materials, computer materials, fax, modem, and phone.

No commuting to class. Study at your own pace, while continuing on your present job. Learn from easy-to-understand but complete and thorough lesson materials, with additional help from our instructors.

Grantham offers three separate distance-education programs, leading to the following accredited degrees;

(1) The B.S.E.T. with Major Emphasis in Electronics.

(2) The B.S.E.T. with Major Emphasis in Computers.

(3) The B.S.C.S. — the Bachelor of Science in Computer Science.

An important part of being prepared to *move up* is holding the right college degree, and the absolutely necessary part is knowing your field. Grantham can help you both ways—to learn more and to earn your degree in the process.

Write or phone for our free catalog. Toll free, 1-800-955-2527, or see mailing address below.

•

Accredited by the Accrediting Commission of the Distance Education and Training Council

•

GRANTHAM
College of Engineering
Grantham College Road
Slidell, LA 70460

Editorial

More Changes?

Ever since I started reading this magazine (in my teenage years) I have appreciated its straightforward, conversational text that immediately involves the reader. By avoiding the use of "engineeringese," **Popular Electronics** has provided educational articles that are entertaining and construction articles that are accessible to project builders of all skill levels. So, in keeping with that simple and effective style, I'd like to say:

Hi.

As you might have read in last month's editorial, Carl Laron, who was Editor of this magazine since the late 1980s, has now taken the helm of our sister publication, **Electronics Now**. But does that mean a change in what you've come to expect from **Popular Electronics**?

Absolutely not. I'd like to take this opportunity to assure you that I plan on keeping to the excellent quality standard that Carl has established for **Popular Electronics**. He's taught me a lot during the past few years that I've been his associate, and I feel honored to be stepping in to fill his position.

So what does the future hold? You won't be disappointed. We've got some great projects and features in the months to come that will be sure to awaken that sense of wonder that got us all into electronics in the first place. The amount of new technology out there is overwhelming, and we're committed to bringing the best of it to your doorstep each month.

This month, our cover story shows you how to build a robot that is fully programmable and easy to assemble, yet made of only a handful of parts. As you'll find out in the Mobile Robot article, the science-fiction-induced childhood dream of having a robot buddy is not too far away. The story begins on page 29.

Dan Karagiannis

Dan Karagiannis
Managing Editor

Breakthrough device creates a wall of silent noise that drives away annoying animal pests...

Now you can use ultrasonic power to repel annoying dogs, cats and many wild animals—without harming them.

by Charles Anton

Be honest. Even if you like animals, you don't want strange animals in your yard. You know what I'm talking about: dogs that dig holes and foul your lawn or cats that trample flowers and sleep on your car.

Common problem. If you live in a rural area, you've probably had trouble with raccoons, skunks or possums. If you live in the southwest, you may even have had problems with armadillos.

Until now, there weren't many options. You wouldn't want to harm a stray animal, and an animal control agency may take days to respond, if they do.

Modern solution. Fortunately, modern technology has provided an answer: the new Yard Gard. It uses high-frequency sound waves to force unwanted animals to leave the area. Yard Gard eliminates the need for repellents, trapping or physical attacks. Pests learn to avoid the areas Yard Gard watches over.

Ultrasonic power. Yard Gard's electronic ultrasonic generator broadcasts powerful "high frequency noises" that repels four-legged yard pests, yet is generally unobtrusive to people.* Tones are harmless, but animals find the sounds unpleasant, so they flee.

Why it works. Small animals depend on their acute hearing for survival. They can hear in the 18 to 25.5 kilohertz range which is beyond the range of most humans. When critical hearing frequencies are disrupted by strong pulses, animals feel threatened and leave the noisy area. Yard Gard takes advantage of this fact to protect your yard from pests.

Break their habits. Animals are creatures of habit. They establish a territory and generally follow the same travel routes. Yard Gard forces animals to change their patterns and establish new ones. They soon modify their habitual routes to avoid Yard Gard zones. Once that has happened, they'll no longer be a an irritating problem.

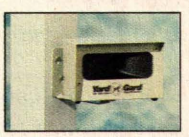
Just plug it in. Yard Gard plugs into any standard household outlet. Electricity consumption is very low and costs only about 25¢ a month to operate.

Yard Gard is designed for outdoor operation in all types of weather. You can use your Yard Gard all year round.

Three settings. Yard Gard has three frequency settings. At its lowest frequency setting, one Yard Gard covers an oval area of approximately 4,000 square feet—the size of an average city lot. Additional units can be added to accommodate especially large yards.

Optional motion sensor. The Yard Gard's optional motion sensor turns the unit on when pests approach, increasing the surprise factor and effectiveness. An optional 50 feet extension cord allows you to place Yard Gard in remote areas that don't have electricity.

Keep the birds. Do you love to watch and feed birds in your yard? If you have problems with cats chasing birds away or killing them, Yard Gard is the answer. Birds are not affected by high frequency sound waves, but cats hate them.



Mount Yard Gard to a fence or porch railing, or place it on a post.

Try it risk-free. For a limited time, you can get the new Yard Gard at the introductory price of just $99. Call today to take advantage of this special factory-direct pricing. Yard Gard is backed by Comtrad's exclusive risk-free home trial. Try it and if you're not completely satisfied, return it within 90 days for a full "No Questions Asked" refund. Yard Gard is also backed by a two-year manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS.

**People that are more sensitive to high frequency sounds may hear the Yard Gard.*

Yard Gard ..... **$99** $12 S&H
Motion Sensor ..... **$39** $4 S&H
Extension Cord ..... **$19** $3 S&H

Please mention promotional code 503-PL-6667.

For fastest service call toll-free 24 hours a day

800-992-2966

AMERICAN EXPRESS VISA DISCOVER MasterCard

To order by mail, send check or money order for the total amount including S&H (VA residents add 4.5% sales tax.) Or charge it to your credit card by enclosing your account number and expiration date.

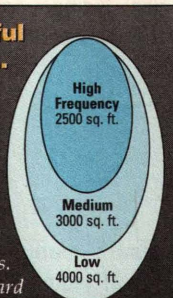
COMTRAD INDUSTRIES
2820 Waterford Lake Drive, Suite 106
Midlothian, Virginia 23113

Are animals turning your yard into a zoo?

Do cats think your garden is a litter box?

Do you have problems with unusual animals?

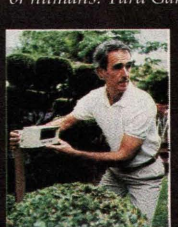
Proven powerful and effective...



In the past, people relied on traps or poisons to get rid of pests. But environmental awareness has increased the demand for clean, non-lethal pest control methods. Safe and humane, Yard Gard is the perfect solution.

Humane. *Yard Gard causes no harm to animals. By creating a wall of high-frequency sound, it forces them to leave the area and create new habitual routes. While the sound is very annoying to animals, it is virtually unobtrusive to people.*

Non-toxic. *Chemicals used to eliminate pests can be dangerous to neighborhood pets or humans. Yard Gard poses no health risk when used properly.*



Nature-friendly. *Poisons and pesticides can pollute soil and water sources. Yard Gard deters pests with sound so it causes no damage to the environment.*

LETTERS

Reader Requests

SWITCHING AMP REVISITED

I am writing about the "Switching Amplifier" article in the April 1996 **Popular Electronics**. In attempting to build this amplifier, I came across the following problem. On page 34, the parts-placement drawing shows C9 on the power-supply board; however, the Parts List does not mention it and the schematic diagram does not show it. Can you clarify the matter for me? I'd appreciate it.

Thank you for an excellent magazine.

S.D.
Don Mills,
Ontario, Canada

Actually, there are labeling problems with two of the capacitors on the power-supply board. Capacitor C9 should actually be labeled C3. The other problem is that two capacitors were labeled C5; the capacitor shown below D4 in the parts-placement should actually be labeled C1.

We apologize for any inconvenience this might have caused.—Editor

CHANGE OF ADDRESS

One of the companies listed in the "Multimedia Watch" column in the May issue of ***Popular Electronics*** *has moved. The new address for CD Titles is 411 Waverly Oak Road, Waltham, MA 12154-8414.—Editor*

HAVES & NEEDS

Here I am, young at heart (I'll be 70 in January), and trying to get into the little black boxes known as ICs. I took a course in radio repair from NRI back in 1943, but I haven't kept up with electronics.

I have a small problem I hope your readers can help solve. I purchased two different Heathkit breadboarding training modules at hamfests. I hope to use them, along with experiments in books and magazines, to increase my understanding of electronics. They work—at least, the power supplies work. Some of the other circuits might work. Of course, the modules did not come with a single piece of information.

One unit is the analog trainer, #3600. I can figure out most of it, except for what was supposed to plug into the back of the unit. On the back are two plugs, and threaded deals to attach something. One plug is a 3-connector, polarized 110-VAC power plug. I have no idea how the other plug, a 60-pin dual inline male connector, connects to the circuit board inside the unit. The connector is soldered directly to the circuit board. What is the pinout and what was the feature intended for?

The other unit is the Digital Design breadboard EI3200. I haven't figured out how to use the onboard clock or any of the features except the +5-VDC and the -12-VDC power. I need to know how to use the LEDs and the clock.

thank you for any help.

DONALD S. LAMBERT
1301 Kiblinger Place
Auburn, IN 46706-3010

I am looking for the user's manual and a schematic for an Electronic Measurements Corporation (New York) Model EMC215 tube and transistor tester, as well as the newest tube/transistor setting book for its twelve bank switches.

JAMES G. RYAN
1619 East 49th Street
Cleveland, OH 44103-2407

I am searching for the service manual and/or schematics for a Fisher video signal controller, Model TFM-190. I will gladly pay the costs for photocopying and shipping. Thank you for any help.

ROBERT H. PFEIL
935 Kintyre Way
Sunnyvale, CA 94087
Tel: 408-245-3490
e-mail: rpfeil@svpal.org

I'm trying to find a schematic and plans for constructing an LED speedometer readout to install on my new rear-wheel drive auto. I became spoiled with the display in my old car—a 1984 Camaro Berlinetta—which had numbers about an inch-and-a-quarter high and segments about an eighth-inch wide. I hope some other readers can help me out. Great magazine!

RAY CARLTON
880 Arlington Place, NE
Atlanta, GA 30306-3911
Tel. 404-872-8615

I'm interested in obtaining any information, including instruction booklets, service manuals, schematics, theory of operation, parts lists, and general information regarding two different items that I am trying to restore. The first is a 1959 "King of Diamonds" pinball machine, manufactured by D. Gottlieb & Co. The second is a Kellogg hand-crank wall telephone. I also need an ear-piece cord for the phone.

LOUIS M. IANNUZZELLI
1315 West 53rd Street
Davenport, IA 52806
Tel. 319-386-7897 (call collect)

I saved from the trash heap an AC/DC instrument calibration standard manufactured by Radio Frequency Laboratory Inc. of Boonton, New Jersey (P/O Model 829B, stock No. 6625-804-4993, contract No. AF 33(604)38770, 115V 10 50 to 400cy). Now I am trying to figure out what to do with it! I have no manuals. Can someone out there help me with information on this big, heavy piece of stuff?

MICHAEL PEARCE
811 East 7th
Superior, NE 68978

continued on page 16

Tell us where it Hz.

From Hertz to Megahertz to Gigahertz, we'll take the pain out of electronics repair. Out of warranty? Well, you're not out of luck. We repair most major brands of electronics and all brands of VCRs. We also do in-warranty service on Nokia® phones and many IBM® products. No wonder we can get your high-tech gear up to specs. After all, we've got the products, the parts and the people to help you put it all together. For a store near you, call 1-800-THE-SHACK.

The Repair Shop at RadioShack℠

CIRCLE 159 ON FREE INFORMATION CARD

NET WATCH

Finding Electronics on the Web

BY DAN KARAGIANNIS

Anyone who has explored the World-Wide Web knows that finding an obscure item is not always easy. To help the lost and confused Internaut, at least a dozen notable search engines exist on the Web, as well as a few sites that let you use those engines simultaneously. However, none of those are exactly perfect (though at least some are getting better).

Netscape - [Electronics Search FAQ - Finding Electronic Design Information on
File Edit View Go Bookmarks Options Directory Window Help
Back Forward Home Reload Images Open Print Find Stop
Location: http://www.eg3.com/srcnet.htm
What's New? What's Cool? Handbook Net Search Net Directory Software
FUJITSU SPARClite™ EMBEDDED MICROPROCESSORS
Leader in Embedded SPARC Microprocessors!
Electronics Search FAQ
Finding Electronic Design Information On The Internet
Vers. 4.0, 1996.04.19 CERA2 - Eg3 - Access Log - EE Toolbox
This FAQ focuses on sources of information useful for electronics and electronics design. At one level, it hopes to help you help yourself - by identifying meta resources such as EE search engines. At another level, it simply identifies the most
Reading file...Done

If you'd like to find an electronics-related piece of information on the Internet, you'll love all the search options the Electronics Search FAQ contains.

A major problem that multiple-engine search sites face is that they have to accommodate "anyone's" request. In other words, whether you're looking for Greek recipes, pictures of galaxies, audio clips of a favorite band or artist, or electronics articles, you're using the same site. What does that mean? It means the sites do not cater to any one particular interest and are therefore not efficient at finding any particular type of information.

Well, this month we'll look at a site that makes it easy to find one type of information: You guessed it, it's electronics. After all, if you're reading this magazine, chances are you are interested in acquiring electronics knowledge and discovering new applications for components. Also, in keeping with the idea that life shouldn't only be about serious pursuits (well, it's my idea anyway), we'll also take a look at the excellent new Twentieth Century Fox site.

ELECTRONICS SEARCH FAQ

Let me start by saying that this great site has a somewhat misleading title. Frequently Asked Question (FAQs) are usually little more than a text list of questions and answers that are commonly sought after in a subject area. This site is much more than that, and, quite honestly, doesn't resemble any FAQ I've seen before. It looks more like a collection of useful resources to finding specific pieces of electronics- and electrical-engineering-related information, and has more than a moderate amount of links to explore.

For starters, the Electronics Search FAQ deals with what it calls "The Big Three," or FAQs, USENET newsgroups, and the World-Wide Web. Clicking on the FAQs and Technical Reports link presents you with options for locating those documents on the Net. Selecting the USENET link presents you with engines for searching through newsgroups for a particular piece of information, and, for those with browsers that support newsgroup access (like Netscape), there are direct links to a *lot* of electronics- and EE- related groups. Finally, the World-Wide Web link lets you use several search engines that the site's creators feel contain a good amount of relevant information.

Interestingly, the Electronics Search FAQ site contains links to a few useful overviews to searching the Net in general. Included are: All-in-One Search Page, Gower.Net, Internet Sleuth, Rice University, Use It, and Yahoo's List. Keep in mind that those are the types of general sites referred to in the beginning of this month's column. However, they can be educational, especially to newbies (new Internet users).

After you've explored The Big Three, you might want to check out a couple of "Oldies but Goodies." The first of those, FTP Sites, is a link to a few great FTP search engines, including my personal favorite, FTPsearch. There's also a recommended FTP site that contains source code and software useful to engineers. Then there's the Mailing Lists link, which I was disappointed in because it had no recommended lists at all, just places to conduct searches for ones that might appeal to you (that includes lists that have nothing to do with electronics).

Some who read that last criticism of mine might be able to argue that it applies, to some extent, to the other

The Four-Year Electronics Degree Program That Really Hits Home!

Bring The Technology Home With A Bachelor Of Electronics Engineering Degree. No Hassles. No High Cost!

Now's the time to prepare for a profitable career.

We've lowered the cost of higher education.

It's true! You can earn a four-year Bachelor of Electronics Engineering Technology degree today ... and prepare yourself for a high-paying electronics career ... without quitting your job or ever leaving your home. Because World College, an affiliate of the Cleveland Institute of Electronics, offers you the total flexibility of independent study programs proven effective for people like you who truly want to succeed! World College independent study lessons help you build valuable skills step-by-step, and expert instructors are personally available to you with a toll-free call. What a way to earn an education!

Mail/Fax Today or Call 1-800-696-7532

A world of opportunity.

Where is your career headed? With a four-year bachelor's degree from World College, you call the shots, choosing from incredible, high-paying opportunities in electronics, telecommunications, computer, electrical power, and many other growing fields.

World College gives you the skills, the knowledge, the power to take advantage of your best opportunity in electronics. And you can do it all at your own pace!

Without leaving home.

World College continually works to provide its students with the most advanced education tools. From the latest equipment and reference books to breakthrough computer-simulated experiments, students are exposed to the latest technological advancements.

All the equipment, parts, and software you need are included in your affordable tuition, including more than 300 hands-on lab experiments you can complete in your home.

Choose your own pace.

Earn your bachelor's degree on your time — and at your pace — because you pay tuition to World College only as you complete the upper-level semesters close to graduation. The faster you make it through, the less you pay. So you have an incentive to make your future happen quickly — yet the freedom to choose your own pace!

Send today for your FREE course catalog — and give yourself that future you've always wanted — with an electronics degree education from World College.

Take charge of your future in electronics.

Four Powerful Reasons To Connect With World College Today:

1. **Earn your four-year degree!**
2. **Self-paced training!**
3. **Independent study in your home!**
4. **Expert instruction!**

Give Me The Power!

Send me a FREE World College course catalog today!

(Please Print Neatly)

Name _____

Address _____

City _____

State, Zip _____

Phone ( ) _____

Age _____

For faster service, call 1-800-696-7532, or call 1-804-464-4600.

Or fax this coupon to 1-804-464-3687.

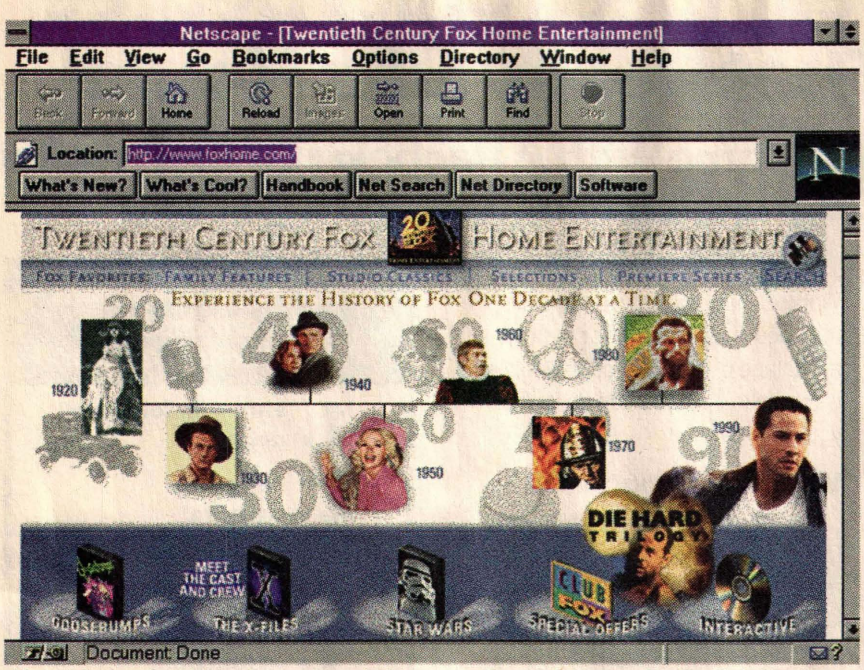
WORLD COLLEGE

Lake Shores Plaza
5193 Drive, Suite 113
Virginia Beach, VA 23455-2500

ICE

Affiliated with
Cleveland Institute of Electronics

WAH31



After eight decades of bringing magic to the big screen, Twentieth Century Fox finally brings its creations to the Internet.

features of the FAQ we've already covered. It's true that the FAQ site does mention a lot of external search engines that could be considered "generic" and not electronics-specific. The FAQ more than makes up for that shortcoming in its last section, however.

The Meritorious Search and EE Resources group of links is easily the most impressive feature of the site. There's a Books, Libraries, Bookstores, Databooks link that can get you going in the right direction when you're looking for some documentation, and an Internet Hot List that will help keep you up to date on topics like Ada and Realtime. Clicking on Internet Employment Resources can help you find a job working with some of the latest technologies, while selecting either the IC-Specific or Microcontroller/Microprocessor Index should make carrying out the design aspects of just about any high-tech job easier.

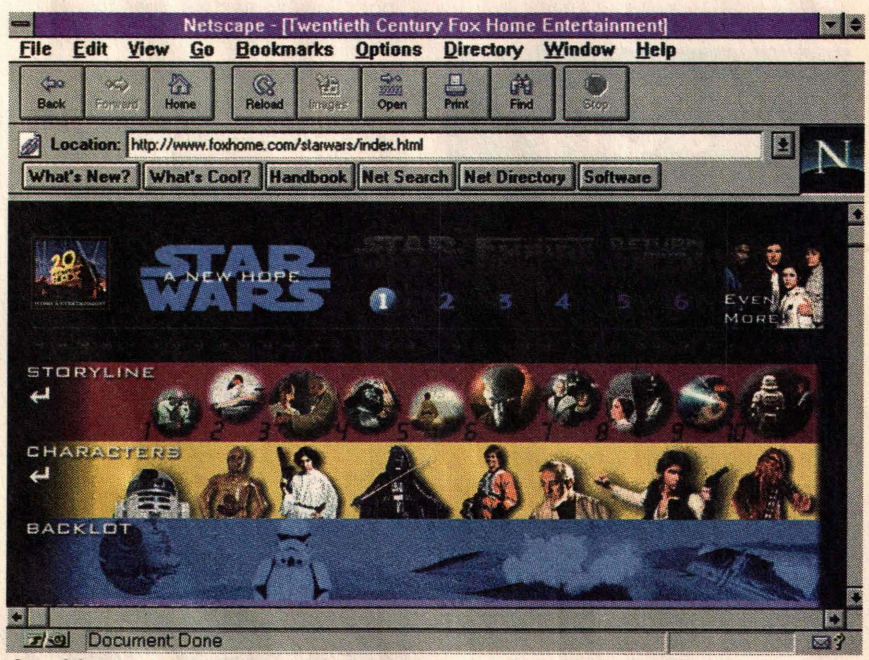
The most impressive feature of them all, though, is the EE Hunter, which is everything a category-specific meta-search engine should be. The EE Hunter unifies search engines at Web sites such as Analog Devices and Texas Instruments, as well as over 20 others. You can easily toggle between the sites, and thereby quickly find online datasheets, news articles, and Web resources. If you only try one feature of the Electronics Search FAQ, be sure to make the EE Hunter your choice.

20TH CENTURY FOX

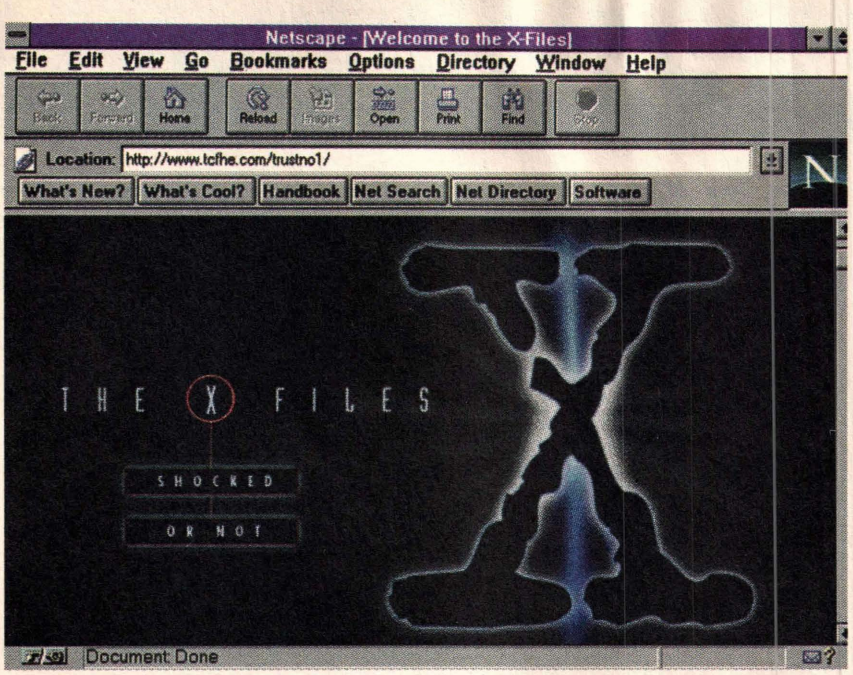
Everyone likes to be entertained. If all we did was work, stress would surely claim us sooner or later. So what do you do to unwind? While each person has his or her own hobbies, one of the pastimes this country enjoys as a whole is watching movies, whether in a theater, home theater, or just in front of a regular TV.

Our next site this month is that of a company that has brought us eight decades of cinematic entertainment—Twentieth Century Fox. At this multisection Web presence, you can relive film history by going through a timeline of old favorites. Just click on the decade of interest to you and learn about the significant events and personalities that shaped the entertainment industry at that time. Those films that had the most impact include extensive information, including high-quality images of their legendary characters (keep in mind they make great Windows wallpaper).

In keeping with our search-engine discussion of earlier, it's interesting to note that the site has its own searchable database of information on any movie in the Twentieth Century Fox Home Entertainment (TCFHE) library. In less time than it takes to burn microwave popcorn, you can find your film favorites by typing in the title, name of a lead actor or actress, release year, name of director, or even which Oscar it won. When you find a title you're looking for, you can go to its page, if there is one (TCFHE plans on adding pages for three films from each decade, every four months), get some


Netscape - [Twentieth Century Fox Home Entertainment]
File Edit View Go Bookmarks Options Directory Window Help
Back Forward Home Reload Images Open Print Find Stop
Location: http://www.foxhome.com/starwars/index.html
What's New? What's Cool? Handbook Net Search Net Directory Software
STAR WARS
A NEW HOPE
1 2 3 4 5 6
EVEN MORE
STORYLINE
CHARACTERS
BACKLOT
Document Done

One of the most popular features of the Twentieth Century Fox site is the Star Wars Trilogy page. You can download great-quality video files and many other types of goodies.


Netscape - [Welcome to the X-Files]
File Edit View Go Bookmarks Options Directory Window Help
Back Forward Home Reload Images Open Print Find Stop
Location: http://www.tcfhe.com/trustno1/
What's New? What's Cool? Handbook Net Search Net Directory Software
THE X FILES
SHOCKED
OR NOT
Document Done

At the X-Files site, you'll find a game where you can take on the role of an investigator and search the Net for clues about a case you're assigned.

important information for research or trivia, or just help yourself decide what movie you want to rent from a local video store.

HOT SITES

Electronics Search FAQ
http://www.eg3.com/srcnet.htm

20th Century Fox Home Entertainment
http://www.foxhome.com

Star Wars Trilogy
http://www.foxhome.com/starwars/index.html

X-Files
http://www.foxhome.com/trustno1

This is truly one of those sites you have to see to appreciate. Movie memories can often bring back some pleasant nostalgia, and finding online goodies relating to a favorite film only adds to that feeling. For example, I particularly enjoyed the Star Wars Trilogy page within the site. I found some really incredible .avi files of scenes from the classic movies, and enough information to keep me busy for hours. Before you visit the site, though, be sure to have your VCR ready to roll one of the *Star Wars* movies. You might find yourself in the mood to do just that by the time you browse just a few of the areas there.

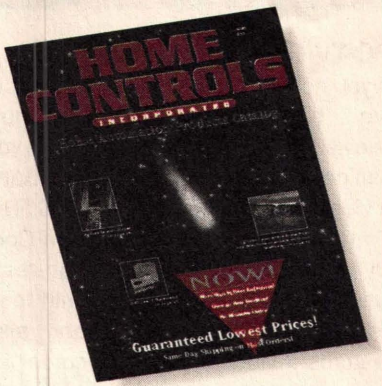
But it's not only nostalgia that keeps the TCFHE site interesting. There are also some excellent Web experiences based on current film magic. Try out the X-Files page to see what I mean. There's an extremely innovative role-playing game you can take part in where you are issued a casefile through e-mail and are then sent onto the Net to collect clues and solve mysteries. Just wait until you see some of the graphics at this site; you'll really get into the game.

That's all for this month. If you'd like to drop me a line, feel free to send e-mail to peeditor@aol.com, or snail mail to *Net Watch*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

ANTIQUE RADIO CLASSIFIED
Free Sample!
Antique Radio's Largest Circulation Monthly. Articles, Ads & Classifieds.
6-Month Trial: $18.95. 1-Yr: $36.95 ($53.95-1st Class).
A.R.C., P.O. Box 802-L16, Carlisle, MA 01741
Phone:(508) 371-0512 VISA/MC Fax:(508) 371-7129

Plant Trees for America™
To receive 10 free Colorado blue spruces, send a $10 membership contribution to:
The National Arbor Day Foundation™
100 Arbor Avenue, Nebraska City, NE 68410

FREE
HOME AUTOMATION CATALOG!



Home Controls' color catalog features truly affordable X-10 powerline controls, IR products, CCD cameras, wireless home control devices, security products, drapery controls, audio systems, and everything you can imagine for the remote and automated control of your home!

Call Toll Free
1-800-CONTROL
Contact us by E-Mail: homectrl@electriciti.com
Lowest Prices Guaranteed • Same Day Shipping • Superior Technical Support
No Minimum Order • Fabulous Freebies • Great Selection!

CIRCLE 158 ON FREE INFORMATION CARD

ATTENTION! ELECTRONICS TECHNICIANS

EARN YOUR B.S.E.E. DEGREE
THROUGH HOME STUDY

Our Highly Effective Advanced-Placement Program for experienced Electronic Technicians grants credit for previous Schooling and Professional Experience, and can greatly reduce the time required to complete the program and reach graduation. No residence schooling required for qualified Electronic Technicians. Through our Special Program you can pull all of the loose ends of your electronics background together and earn your B.S.E.E. Degree. Upgrade your status and pay to the engineering level. Advance rapidly! Many finish in 12 months or less! Students and graduates in all 50 states and throughout the world! Established Over 50 Years! Write or call for free Descriptive Literature. (601) 371-1351

COOK'S INSTITUTE
OF ELECTRONICS ENGINEERING
CIE 4251 CYPRESS DRIVE
JACKSON, MISSISSIPPI 39212

New Products

PC/TV CARD

If you don't want to wait—and shell out big bucks—for the hot new television/computer combinations, you can get a similar effect today by adding a video/television card to your PC. The *DynaMax Hi-Rez Plus* card from Core Dynamics is an interactive, high-resolution card that provides you with "personal-theater enjoyment," and also features a video snapshot recorder for image capture, and on-board spatial stereo sound.

The Hi-Rez Plus lets you use your PC to watch TV, videos, or home movies; capture images for personal home page use or for video albums; receive financial updates; and play video games. It can also be used to create an inexpensive security or local video-conferencing system, or to add video snapshots to school assignments. Television functions include automatic channel surfing; five "hot channel" buttons; and NTC, PAL, or SECAM support. It displays 16.7 million colors at full frame and full motion (30 frames per second).

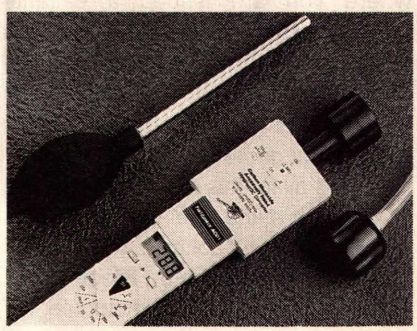
The video/television card is compatible with all VGA cards, without the need for internal cables. It supports up to 1280×1024 resolution. The 8-inch ISA bus card provides easy installation with true Plug-n-Play capabilities. It requires a Windows 3.1X- or Windows 95-compatible 386, 486, or Pentium PC with an ISA bus slot, a VGA monitor, and a VGA or SVGA graphics card.

The DynaMax Hi-Rez Plus card, complete with installation manual, VCR input cable, loopback cable, Windows 95 and Windows 3.1X software drivers, four CD-ROM titles (ESPN's *Baseball Tonight*, CNN's *Time Capsule*, *A Guided Tour of Multimedia, Second Edition*, and Corel's *PhotoPaint 5 Special Edition*), and a trial subscription to *Multimedia World*, costs $299. For more information, contact Core Dynamics, 8 Thomas Street, Suite 100, Irvine, CA 92718; Tel. 800-611-CORE; Web: http://www.core-dynamics.com.

CIRCLE 80 ON FREE INFORMATION CARD

CARBON-MONOXIDE DETECTOR DMM ACCESSORY

Fieldpiece Instruments' Model ACOK2 Carbon Monoxide Kit allows users to detect, in seconds, dangerous carbon-monoxide concentrations in ambient air, from registers, or even from more pinpointed sources. Designed specifically for use with a Fieldpiece "stick" digital multimeter, the kit includes the ACO1 carbon-monoxide snap-on head and the ACOP1 pump extension for pinpoint samples. The head and pump can be connected to most other digital multimeters using Fieldpiece leads.



The head slides onto the DMM to convert carbon-monoxide concentration in parts per million (ppm) to mV (millivolts) DC. Setting the meter on 200-mVDC or 2000-mVDC range displays carbon monoxide in ppm, with an accuracy of 5% ±3 ppm. The easy-to-use head is small and lightweight and has a long battery life. The catalytic sensor has been known to last for more than seven years and remain properly calibrated; life and accuracy may vary depending upon use, abuse, and exposure to harmful chemicals.

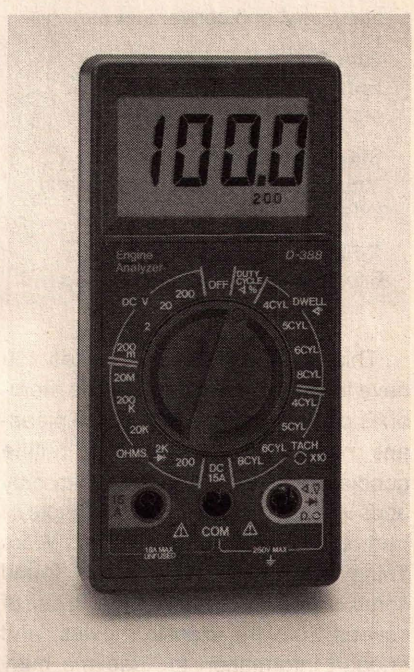
The pump extension requires no batteries and fits easily onto the head to measure carbon-monoxide levels at a specific point. Squeezing the pump's bulb samples air at the tip of the probe.

The ACOK2 Carbon Monoxide Kit costs $399. For more information, contact Fieldpiece Instruments, 231 East Imperial Highway, Suite 250, Fullerton, CA 92635; Tel. 714-992-1239; Fax: 714-992-6541.

CIRCLE 81 ON FREE INFORMATION CARD

MULTI-FUNCTION AUTOMOTIVE TESTER

HC Protek's Model D-388 handheld automotive tester provides a variety of measurement functions for budget-conscious professionals and do-it-yourselfers. It is designed for the performance testing of sensors, batteries, cables, fuses, voltage, wiring, and connections; spark plugs, switches, and bulbs; carburetor feedback, breaker point, and solenoid dwell; engine rpm; and accessories, radios, and modules.



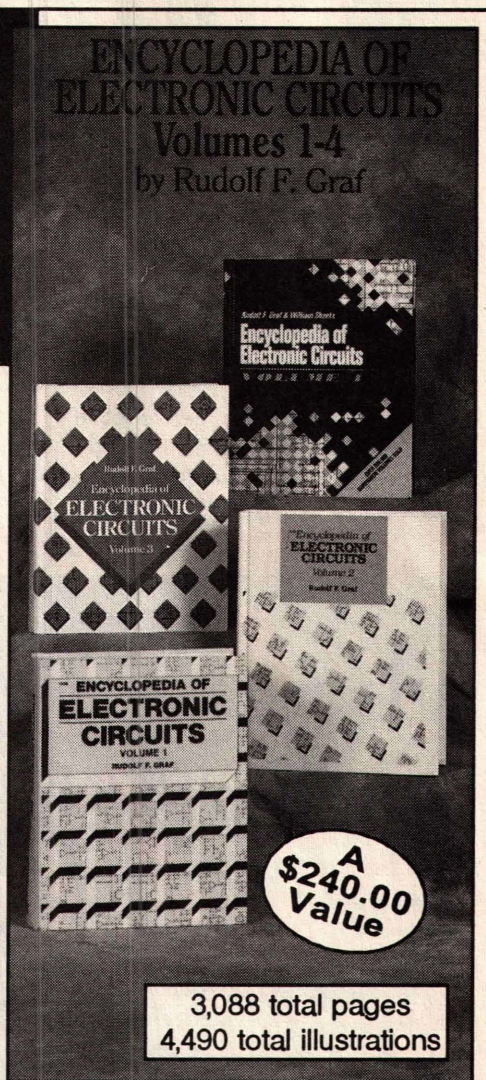
The 3-1/2 digit, 2000-count multimeter measures voltage, resistance, amps, rpm, duty cycle, and dwell, and performs diode tests. Its large LCD readout features a unique sub-display

continued on page 74

Take this GIANT CIRCUIT LIBRARY FOR ONLY $14.95

when you join the

Electronics Engineers' Book Club®



Hundreds of circuit ideas alphabetically arranged–from Alarm circuits to Zero crossing detector circuits!

Turn to this comprehensive circuit library for hundreds of project ideas...and concise pinout diagrams and schematics. In each volume you'll find more than 700 electronic and integrated circuits and 100+ circuit categories right at your fingertips to give you ideas you can use on the job or at your workbench.

As a member of the Electronics Engineers' Book Club®...you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. And you'll be eligible for FREE BOOKS through the Bonus Book Plan. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time. Publishers' price shown. ©1996 EEBC

If coupon is missing, write to: **Electronics Engineers' Book Club,**
A Division of The McGraw-Hill Companies, P.O. Box 549, Blacklick, OH 43004-9918

MONEY-SAVING BONUS OFFER!

Take the *ENCYCLOPEDIA OF ELECTONIC CIRCUITS Vol. 5* at 50% off Publishers' price

Publisher's price-$60.00

ELECTRONICS ENGINEERS' BOOK CLUB® *A Division of The McGraw-Hill Companies,* P.O. Box 549, Blacklick, OH 43004-9918

YES! Rush me the *Encyclopedia of Electronic Circuits–Vols. 1-4* (5861488), billing me just $14.95 plus $12.00 shipping/handling & sales tax. Enroll me as a member of the **Electronics Engineers' Book Club** according to the terms outlined in this ad. If not satisfied, I may return the books within 10 days for a full refund and my membership will be cancelled. I agree to purchase just 3 more selections at regular Club prices during the next 2 years and may resign anytime thereafter.

☐ **BILL ME** (Bonus offer not available with this option.)

SPECIAL OFFER! Prepay your order by check, money order, or credit card and receive the *Encyclopedia of Electronic Circuits–Vol. 5* for $30.00 (That's 50% off the publisher's list price!)

☐ **50% MONEY-SAVING OPTION:** I also wish to order Vol. 5 (011076X) at 50% off the Publishers' price. I then need to purchase only 2 more books within the next 2 years. According to the terms outlined, my payment of $56.95, plus applicable sales tax is enclosed.

☐ Check or money order enclosed made payable to: The McGraw-Hill Companies

Please charge my: ☐ VISA ☐ MasterCard ☐ American Express ☐ Discover

Acct. No. _____ Exp. Date _____

Signature _____ Phone _____
(required on all orders)

Name _____

Address/Apt. # _____

City/State/Zip _____

Offer valid for new members only, subject to acceptance by EEBC. U.S. orders are shipped 4th Class Book Post. Canada must remit in U.S. funds drawn on U.S. banks. *Canadian orders are shipped International Book Post–add $16.00 shipping/handling. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders.

PPIF996

Multimedia Watch

WinHEC '96 and Great Software for Kids

By Marc Spiwak
Technical Editor
Windows Magazine

I attended the Windows Hardware Engineering Conference for 1996 in the beginning of April. The purpose of this conference is for computer hardware engineers to get together and go over the general design goals for the PC of 1997. Bill Gates, who made the keynote speech on opening day, would like to turn the PC into an appliance. It should be able to do anything required of it, and set up and configuration should become non-issues. Inexperienced users should be able to immediately play a game, watch a movie, write letters and send e-mail, browse the Internet, hook up another device, or listen to voice messages.

I also sat in on lots of seminars and met with some vendors. The in-depth discussions at these seminars were, for the most part, over my head, but I did pick up a lot of general information on what we can expect to see in PCs down the road. For example, one seminar discussed what's necessary to turn the PC into a home entertainment center. Basically, PC audio needs tremendous improvement, display size must increase, and more sophisticated software is needed.

Audio will eventually be 8-channel 3D sound, and digital audio output is planned. The digital audio is great—it's more immune to noise and has higher S/N ratios. Also display size will increase as various techniques are used to produce a decent picture on an NTSC/PAL monitor. But basically, these displays are already here. Gateway 2000's new Destination system's big-screen monitor is actually a conventional TV tube with some enhancements and VGA electronics installed.

Another seminar talked about the new USB (Universal Serial Bus), which is intended for low-speed connections and IEEE 1394 for high-speed. USB has a peak bandwidth of 12 MB/s with a 4-wire connector. 1394 presently has a 400 MB/s bandwidth with a 6-wire connector, and bandwidth will increase to 2 GB/s in the future. Eventually a PC will become a sealed case with a 1394 interface being the only way to connect other devices. Devices will be hot-swappable with regulated power supplied by the interface. New devices will automatically configure themselves, much like a PCMCIA card. Consumer electronics (TVs, VCRs, cable boxes, camcorders, etc.) will eventually have the same interfaces.

Yet another seminar discussed advanced power management. Efforts are now under way to build PCs that will appear to be off at all times until you need to use them. Then they become instantly available like TV's. A "sleeping" PC will be able to unobtrusively wake itself up for routine maintenance (disk scanning, backups, etc.), and also be able to wake for modem rings and such.

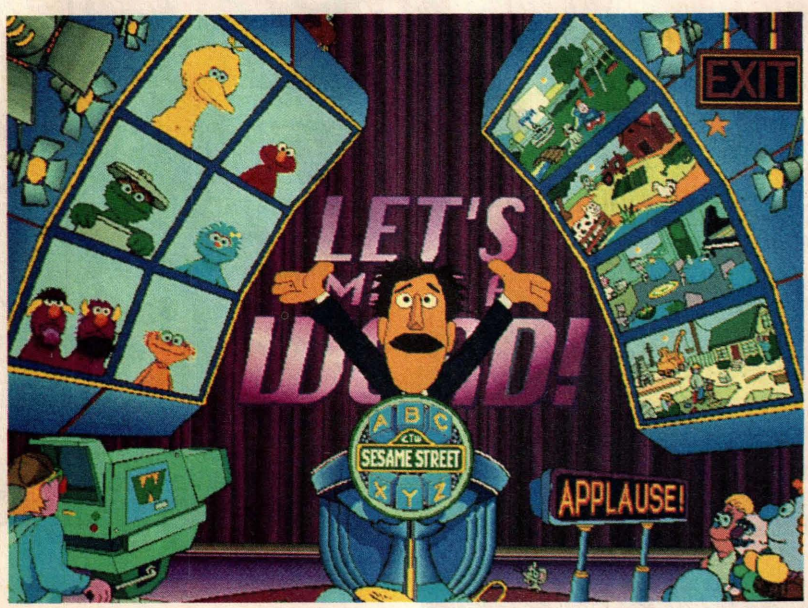


Fig. 1. Let's Make a Word, featuring Guy Smiley as its host is a multimedia Sesame Street game show.

GREAT KID SOFTWARE

My son is growing fast. He's about a year and a half now, and soon he'll start taking an interest in my computer. Not that he isn't already interested in it—it's just that at this point in time he prefers to bang on the keyboard or pull it off the desk and let it dangle by the cord.

When my son is ready for the computer, he'll have a nice collection of children's software waiting for him. Having a child makes me interested in the children's software that comes my way, and this month I have some very nice software for kids. My son already loves *Sesame Street*, so I'm sure he will like the software I have waiting for him from the Creative Wonders division of Electronic Arts: *Get Set To Learn, Art Workshop, Letters, Numbers*, and *Let's Make a Word*. These are all intended for ages 3 to 6

and have a suggested retail price of $34.95 each.

Get Set To Learn prepares kids for kindergarten by developing thinking and problem-solving skills through working with shapes, patterns, sets, sizes, colors, and more. Art Workshop lets kids create artwork by pasting "stickers" into scenes, putting costumes on characters, and working with coloring books; and none of it's at all messy! Letters and Numbers teaches alphanumeric skills with interactive games, songs, reading, shape identification, addition and subtraction, and so on. Let's Make a Word features Guy Smiley as the host of a Sesame Street game show that teaches words and fun at the same time.

Fig. 2. (CD Creator 2.0 makes it very easy to record your own CDs if you have a CD-R drive. The 32-bit software recognizes and works with many popular CD-R drives.

Recently I received two copies of *Gearheads* from Philips Media, a wacky strategy game where 3-D animated characters battle it out. I gave one copy to a friend who has a 5-year-old son. The graphics were cool but in my adult haste I couldn't figure out how to play it, much to the disappointment of the 5-year old. They went out for the day with their son anxious to get back and play the game. He ran upstairs when they got home, turned on the computer, and was busy playing Gearheads when my friend and his wife went upstairs 10 minutes later. This game sells for $39.99 and gets two thumbs up from a 5-year old.

Also from Philips Media is *Masterpiece Mansion*, a game that houses a 3-D-rendered mansion loaded with over 150 pieces of famous artwork. The player is trapped in the mansion and the only way to get out is to solve puzzles and games centered around the artwork. Background information on the art and the artists helps the player solve the game. This one sells for $39.99.

Speaking of 3-D-rendered worlds, *Connections*, from Discovery Channel Multimedia, is a game where you go from one environment to the next, looking for clues to help figure out how you got to this place and how you will get out. The game is based on James Burke's television show *Connections* on The Learning Channel. The game has a suggested retail price of $49.95.

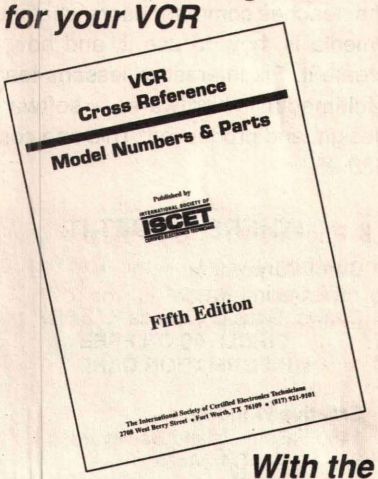
OTHER NEW SOFTWARE

While on the topic of rendering things in 3-D, I should mention *myHouse 2.0* from DesignWare, Inc., which lets you design homes, interiors, and landscaping in 3-D. You can create 3-story plans, remodel rooms, and more. The software features automatic wall dimensioning, over 750 drag-and-drop symbols, adjustable gridpoints, a roof designer, and everything else you need to create the house of your dreams. You can even create movie walk throughs of your plans, all for $84.95.

Corel recently sent me its new *CD Creator 2.0* software designed for Windows 95. This 32-bit software makes it very easy to record your own CDs, but only if you have a CD-R drive. The 32-bit software recognizes and works with many popular CD-R drives, and makes short work of preparing data discs, audio discs, mixed-mode discs, and more. It can even help you design artwork for CD jewel boxes. Simple wizards allow you to make direct copies of other discs. The software is easy to use and does as much as possible to help you avoid errors when making CDs. CD Creator 2.0 has a suggested retail price of $495. Users of the previous version can upgrade for only $99.

VCR Cross Reference

NOW Find the right Part for your VCR



With the

ISCET VCR CROSS REFERENCE

This 119-page reference contains both model and part-number cross-references updated to include 1994 units.

VCR's are made in a few factories from which hundreds of different brand names and model numbers identify cosmetically-changed identical and near-identical manufactured units. Interchangeable parts are very common. An exact replacement part may be available only a few minutes away from you even though the manufacturer supplier is out-of-stock. You may be able to cannibalize scrap units at no cost!

The ISCET VCR Cross Reference is pre-punched for standard loose-leaf binding. . .$38.00 plus $3.00 for shipping for each Reference.

Claggk Inc.
VCR CROSS REFERENCE OFFER
P.O. Box 4099
Farmingdale, New York 11735-0793

Name _____
Business _____
Address _____
City _____
State _____ Zip _____
Phone _____

Enclose **$38.00** for the Fifth Edition of the ISCET VCR Cross Reference and **$3.00** for shipping for each Reference.
The total amount of my order is $ _____
Check enclosed—do not send cash.
or please charge my credit card.
☐ Visa ☐ MasterCard Exp. Date ___/___/ ___
Card No. _____
Signature _____

New York State residents must add applicable local sales tax to total. US funds only. Use US bank check or International Money Order. CB02

Graphix Zone sent me a copy of its new CD-ROM, *The Guided Tour of Multimedia/2nd Edition*. This update to the first edition is an interactive tutorial that teaches computer users what multimedia is, how to use it, and how to create it. Six interactive lessons teach Multimedia hardware, software, design, and production. This one costs $39.95.

WHERE TO GET IT

Corel Corporation
1600 Carling Avenue
Ottawa, Ontario, Canada K1Z 8R7
CIRCLE 60 ON FREE INFORMATION CARD

Creative Wonders
1450 Fashion Island Boulevard
San Mateo, CA 94404
CIRCLE 61 ON FREE INFORMATION CARD

DesignWare, Inc.
17 Main Street
Watertown, MA 02172
CIRCLE 62 ON FREE INFORMATION CARD

Discovery Channel Multimedia
7700 Wisconsin Avenue
Bethesda, MD 20814
CIRCLE 63 ON FREE INFORMATION CARD

Dr. Schueler's Health Informatics, Inc.
P.O. Drawer 410129
Melbourne, FL 32941
CIRCLE 64 ON FREE INFORMATION CARD

Graphix Zone
42 Corporate Park, Suite 200
Irvine, CA 92714
CIRCLE 65 ON FREE INFORMATION CARD

Philips Media
10960 Wilshire Blvd., Seventh Floor
Los Angeles, CA 90024
CIRCLE 66 ON FREE INFORMATION CARD

Phoenix Publishing Systems, Inc.
8 Harris Court, Bldg. A
Monterey, CA 93940
CIRCLE 67 ON FREE INFORMATION CARD

While I'm on the subject of tutorial-type software, I might as well mention some from Phoenix Publishing Systems. They are shipping a full line of *Discover* software designed to help users pick up the small points of different software titles. The Discover titles include *Windows 3.11, WordPerfect 6.1, Excel 5.0, Word 6.0, PowerPoint 4.0, Access 2.0*, and *Windows 95*. Each one is available in either a home or professional version, with the professional versions being more detailed and geared toward the average business user.

Frommer's Interactive Travel Guides are a series of multimedia guides based on the popular travel guides in print. The Multimedia travel guides from Macmillan Digital USA feature the full text of the printed guides plus supplemental listings for hotels, restaurants, ATMs, parking garages, hospitals, and more. With a laptop computer and one of these guides, you're ready to travel.

Last this month is a 6-CD value set from Dr. Schueler's Health Informatics that's designed to keep your family in good health. *Dr. Schueler's Medical Center 6* contains *Disease Prevention Made Easy, Virtual Autopsy, The Doctor Is In, Secrets To Burn Fat & Build Muscle Fast, Pharmacist On Call*, and *Adventures In Anatomy*. The 6-disc set will sell for the bargain price of around $35. ■

LETTERS

(continued from page 6)

I have a radio-detector-type S.E. 183A, serial number 2611, which was made for the Navy Department Bureau of S.E. by Wireless Specialty App. Co. of Boston, Massachusetts. It has three crystal contacts.

I hope that some of my fellow **Popular Electronics** readers can tell me about it, including the year it was used on ships. Any information would be appreciated. Thank you in advance for any help.

KENT MUELLER
30 Hamilton Avenue
Clifton, NJ 07011

A few years ago, Popular Electronics offered free fact Cards. I need a copy of the guitar preamplifier circuit.

I would appreciate it if someone could send me a copy.

GENE HENKEMEYER
409 24th Avenue North
St. Cloud, MN 56303
Tel. 612-363-4444

HOW MINE TURNED OUT

As a copier technician, finding squeaks and rattles is an everyday battle. So when I saw Charles Hansen's article, "Build the Auto Stethoscope," in the April 1995 issue of **Popular Electronics,** I knew there was hope.

Although I have an EET degree, I had never built an electronic project before. However, the Stethoscope plans looked so good, I was sure it would work. I decided to go to Gateway Electronics to get the components.

I found a PC-board-making process where the artwork is copied onto a transparency, ironed onto a piece of copper-clad PC-board material, and etched off. It took about one hour. Except it was a mirror of the art! Oops! Turning over the transparency solved the problem.

I drilled the board and stuffed the components. The soldering went quickly and there were no problems. I put it in a Radio Shack box and used a Radio Shack 4-pin connector to make the microphone connection nice and neat.

The plans called for a 3-wire microphone, but Radio Shack was out, so I had to use a 2-wire microphone. A 20-μF capacitor wired between signal and power for the microphone solved that problem.

When I powered it up, the Stethoscope gave a lot of feedback at high volume, So instead of using walkman headphones, I mounted a pair of 8-ohm B speakers wired in series into a set of shooting ear muffs. That actually solved the feedback problem quite nicely.

No design is ever really done. But I can't think of another way to improve this one. The proof of that is that my boss borrowed my Stethoscope and hasn't given it back yet. So I might have to build another one. By the way, it also makes a great shop amp.

I thank the author for a good design and a good project. I look forward to seeing more useful projects like the Auto Stethoscope in the future. Keep up the good work you've been doing.

D. M. W.
Lakewood, CO ■

GIZMO®

You've Come a Long Way, Baby

The Personal Computer: Yesterday, Today, and Tomorrow

Stroll through any of today's computer emporiums and you'll be dazzled by the seemingly infinite selection of powerful, reasonably priced personal computers, complete with all the (now standard) bells and whistles: color monitors and printers, multimedia capability, and extensive software packages. It's hard to believe that only 20 years ago, the computer market barely existed. In this month's **Gizmo**, we'll take a quick look at where the PC got its start, where it's at right now, and where it's likely headed in the near future. We'll also take a look at two PC packages that we consider representative of today's market.

A BLAST FROM THE PAST

The year was 1976, and the "home computer" market included the Altair B, S-100 machines, SOL, and SWTPC 6800s. It would be another five years before the IBM PC would burst upon the scene, and Apple Computer Company was a mere seedling.

Early in 1977, Apple began advertising "the First Low Cost Microcomputer System with a Video Terminal and 8K Bytes of RAM on a Single PC Card, for $666.66." You had to add your own case and monitor to the bare-board system. Later that year came the Apple II, fully built and ready to use—no soldering iron required. The system was affordable, and useful software was available for it. Apple soon gathered an enthusiastic following.

Apple wasn't the only player at the time. Cromemco, Sphere, and Ohio Scientific are names that only computer-history buffs would recognize today. But a couple of late-70s entries carved out lasting places in computer history: the Commodore PET ("Personal Electronic Transactior") and Tandy's TRS-80.

The PET, which made its official debut at the June 1977 Consumer Electronics Show, came with either 4K or 8K of RAM, a built-in monitor, a calculator-style keyboard, and a built-in cassette recorder for storing and loading programs—all for $795. The first TRS-80s went on sale in the summer of 1977. For just under $600, they came with 4K of RAM, but couldn't be connected to a printer. Radio Shack carried a line of preprogrammed software cassettes, all based on the TRSDOS operating system, which was not compatible with CP/M, the de facto standard operating system of the time.

The early 80s saw the introduction of the most popular home computer of its day—the Commodore 64, with a music-synthesizer chip, 16 colors, easy-to-use graphics, a plug-in floppy-disk drive, and a whopping 64K of RAM. The Commodore 64 could be purchased at K-Mart for a mere $400.

Atari's 400 and 800 and the TI 99/4A from Texas Instruments also had their dedicated followings. Yet those home computers, as well as the TRS-80 and the PET, appealed to a fringe group of buyers—primarily hobbyists and video-game enthusiasts. They never truly penetrated the home market; the closest the average consumer came to a "computer" was game-playing on an Atari 2600. Even in the business world, personal computers had yet to appear.

It took the power of a big name to give the computer a sense of legitimacy. And when that name appeared on the front of a microcomputer in 1981, the IBM PC flew off the dealers' shelves—even though the basic model featured only 64K of RAM and a cassette port for mass storage. IBM could barely meet the demand as volume orders poured in from large corporations.

As sales increased, so did the demand for software. Software developers, including, of course, Microsoft, rushed in to fill that need. As more applications became available, people began to see a reason—or, at least, feel a desire—to have a computer in the home as well as in the office.

IBM's first computer designed specifically for the home market, the PCjr, was introduced in late 1983 to mostly glowing

reviews—and a distinct lack of interest from consumers. It ran PCjr software, which at the time of its introduction, consisted of five games. The PCjr was "compatible" with IBM PC software, but it didn't have the memory required to run it. As the corporate PC market boomed, the home computer market remained stagnant, at least from the standpoint of the average consumer.

For hobbyists, however the 1980s was an exciting time. Magazines such as *Radio Electronics*, **Popular Electronics**, and relative newcomer *Byte* had been publishing plans for building computers since the mid-1970s. By the early 80s they were joined by *Computer Shopper*, which gave would-be computer builders ready access to sources for the parts they needed.

By the mid-80s, IBM had added the XT and AT to its line of personal computers, and MS-DOS-based clones were popping up everywhere. It wasn't long before TRS-80 and CP/M machines went the way of the dinosaurs, with only Apple's Macintosh (and the Commodore Amiga) hanging in to challenge IBM/Microsoft's market dominance.

For years, the way to get the most bang for your computer bucks was to get your hands dirty and do it yourself. Even if you didn't start from scratch with plans from a magazine, you could save money buying a bare-bones machine and then upgrading parts ordered by mail or picked up at computer fests. As long as you knew your way around the inside of a computer case, you didn't have to worry that your computer would become obsolete—at least, not right away.

THE HERE AND NOW

All that has changed over the past few years. It isn't that improvements are slower in coming. In fact, the computer you buy today will be somewhat outdated by the time you bring it home. But as quickly as memory and CPU speed have increased, so have prices dropped. In today's personal computer market, you can get a top-of-the line, Pentium 166 computer with full multimedia and telecommunications capability for about what the IBM PC cost back in 1982. What to do with the 486 you bought a few years back? The kids can use it for school work—although you'll probably find them sneaking game time on your new multimedia PC.

PCs have truly become family purchases. More than 40% of U.S. households currently own at least one personal computer. And that percentage continues to increase steadily as more adults establish home offices, students require the power of a PC to stay competitive, and people of all ages seek Internet access.

Gateway's Destination might foreshadow what the future holds in store for PCs. It combines the functions of TV with a multimedia PC.

So what do you look for when buying a home PC? We hate to answer a question with a question, but: What will you use it for? You won't be able to make intelligent decisions about what type of computer will best suit your needs until you determine just what your needs are. Do you just want to play games? Will you handle your family finances electronically? Does your home business require graphics-intensive applications?

There are two reasons to figure out what types of software you'll be using before you decide on your hardware configuration. First, you want to be sure that the system you buy is fast and powerful enough to handle all your applications. Second, most of today's PCs are sold with bundled software packages thrown in. Look for the package that best meets your needs. You don't want to bring your new PC home only to find that you immediately have to go out and buy more software.

The next major factor to consider is your wallet. Unless you're as rich as Bill Gates, there's probably a limit on the amount of funds you can spend on a new PC. You might have to make some trade-offs to stay within your budget. Let's take a look at the various factors that go into a PC, and that affect its price.

At the heart of any PC is the central processing unit, or CPU. Forget about anything other than a Pentium. Computers become obsolete fast enough even if you don't buy the latest and greatest. Anything less than a Pentium 100 or compatible coprocessor won't do.

The next step up from a Pentium is the more powerful and sophisticated Pentium Pro, which is just beginning to trickle down to consumer/SOHO systems—at very high prices. And, at least for now, you're not likely to get extra performance for your extra dollars. That's because the Pentium Pro was designed for use with 32-bit operating systems, specifically, Windows NT. Windows 3.1 is a 16-bit system. Windows 95, which is a 32-bit system, uses quite a bit of 16-bit code so that it would be compatible with existing programs. Most home applications won't see any benefits from the Pentium Pro.

The CPU's speed is measured in megahertz. The higher the number, the faster the machine—and the higher the price. Pentium systems are available in 75-, 100-, 120-, 133-, 150-, and 166-MHz configurations. The 150- and 166-MHz are faster than most people really need right now, but they are likely to become obsolete more slowly.

The next number the computer shopper is confronted with is megabytes (MB) of RAM (random access memory). One byte equals the amount of data required to form a single alphanumeric character; one megabyte equals one million bytes. It isn't smart to skimp on RAM, the temporary storage space for the files and applications on which you are currently working. If you don't have enough RAM, your computer will be sluggish, and it might not be able to handle some powerful applications (particularly graphics-intensive ones) at all. Spring for 16 MB of RAM if you can afford to; 8 MB is the minimum you should consider.

Permanent storage is done on the computer's hard drive, and these days it's mea-

Gizmo is published by Gernsback Publications, Inc., 500 Bi-County Blvd., Farmingdale, NY 11735. Senior Writers: Chris F. O'Brian and Teri Scaduto. Copyright 1996 by Gernsback Publications, Inc. Gizmo is a registered trademark. All rights reserved.

sured in gigabytes. (A gigabyte is equal to one billion bytes.) Every program you install, and every file you create, uses up some of that permanent memory. One gigabyte is the absolute minimum you should consider today; a better bet is a system that includes a 1.2- or 1.8-GB hard drive.

Your computer can serve as your gateway to the entire world, as long as it is equipped with a modem. Modems use standard phone lines to exchange data with other computers—sending e-mail from your home office to someone at the main office, or surfing the Net. The speed of a modem—the amount of time it takes to transfer data—is measured in kilobytes per second, or kbps. If you plan to be online at all (and you probably will be eventually, even if you aren't planning on it now) look for at least 28.8 kbps. And it makes sense to look for a fax/modem, which most new PCs offer, so that you can send faxes from your computer and receive them as well.

Make sure your new PC has multimedia capabilities. Audio and video will enhance your computing experience, and many applications are now available only on CD-ROM. Even if you don't plan to immediately use any multimedia applications, you can use your CD-ROM drive to play audio CDs while you work. A quad-speed CD-ROM drive, state-of-the-art a year or so ago, is now the minimum to look for. A 6× drive is better, and 8× drives are now available. Videogame junkies, in particular, should splurge on the higher-speed CD-ROM drives.

Multimedia, by definition, includes video and audio. Guidelines published by the Multimedia PC Working Group for multimedia PCs specify MPEG video and a 16-bit, "wavetable" sound card, which produces CD-quality sound. Multimedia systems also include microphones for adding your own audio, and shielded stereo speakers, which can be mounted right next to your monitor without causing any interference.

The monitor is not always included in the price of a PC package. Monitors, like TVs, are measured diagonally. The most popular sizes are 14 and 15 inches, but 17-inchers are making inroads, particularly among users who spend a lot of time working on spreadsheets, computer-aided design work, and desktop publishing. Remember, though, a 17-inch monitor isn't as big as a 17-inch TV because PC manufacturers don't conform to the same FTC regulations when measuring screen sizes.

Besides size, you'll want a monitor that's SuperVGA-capable (SVGA) with a dot pitch of 0.28 or smaller and a resolution of at least 1024 × 768. Make sure the

(Continued on page 26)

Standing Apart from the Crowd

COMPAQ PRESARIO 9240. Manufactured by Compaq Computer Corporation, P.O. Box 692000, Houston, TX 77269-2000. Tel. 713-514-0484. Price: $2799.

Walk in to your local computer super store, and you'll be confronted by between one- and two-dozen different computer systems on the shelves. On the outside, they might look deceptively similar. You'll want to compare each one, however, to *Compaq's Presario 9240*.

The Presario 9240 is powered by an Intel Pentium running at 133 MHz, and is equipped with 16 megabytes of RAM in its standard configuration. Its mass storage is provided by a 1.2-gigabyte hard disk drive. Its 4× CD-ROM drive is one of the most interesting features—it's also a new PD-CD rewriteable drive, providing 650 megabytes of removable storage. A built-in fax/modem (28.8 kilobits per second data, 14.4 kbps fax) also provides voice telecommunication and even acts as a telephone-answering machine. Our system was also equipped with a new Compaq keyboard that does double duty as a text and graphics scanner.

By the time you read this, Compaq's fall lineup should be hitting the shelves of your neighborhood computer super store. However, the features of the 9240 are indicative of what you can expect from the new line.

The 9240 is designed with the home office in mind, but it doesn't neglect multimedia applications. The minitower case is one of the best we've ever seen. In Compaq tradition, large, finger-openable screws hold on removable side panels. On one side of the minitower case, the motherboard is mounted vertically. It plugs into a kind of backplane that runs along the bottom of the case. The backplane provides the expansion slots for plug-in accessories, and also the connectors for the floppy- and hard-disk drives.

Opening up the case for access to the expansion slots reveals a refreshingly empty box. The 9240 offers three AT slots, one PCI slot, and one additional slot that can be occupied by either an AT or PCI expansion card. As shipped, the 9240 has one PCI slot occupied—a SCSI card that controls the PD-CD drive.

These days, most people try to avoid ever going inside their computer cases. The 9240 is shipped with a full complement of accessories that should make add-ons unnecessary for quite a while. But, because the computer industry doesn't sit still, it will almost certainly become necessary to upgrade something or other.

Most of the things that would normally occupy expansion slots are contained on the motherboard—the PCI local-bus video, for example. Our computer was shipped with an added megabyte of video RAM plugged in on the motherboard. The IDE controller for floppy and hard drives is also motherboard-contained, but the connectors are brought over the expansion side of the case by the backplane board. Also on the motherboard are the sound "card" and parallel and serial ports. The modem is contained on a separate card, which plugs into the "feature slot" on the motherboard-side of the case.

Unlike some of the computers that have crossed our desks recently, the 9240 is refreshingly quiet. A single fan handles

the cooling, yet the processor's heatsink wasn't excessively hot according to our "fingertip test."

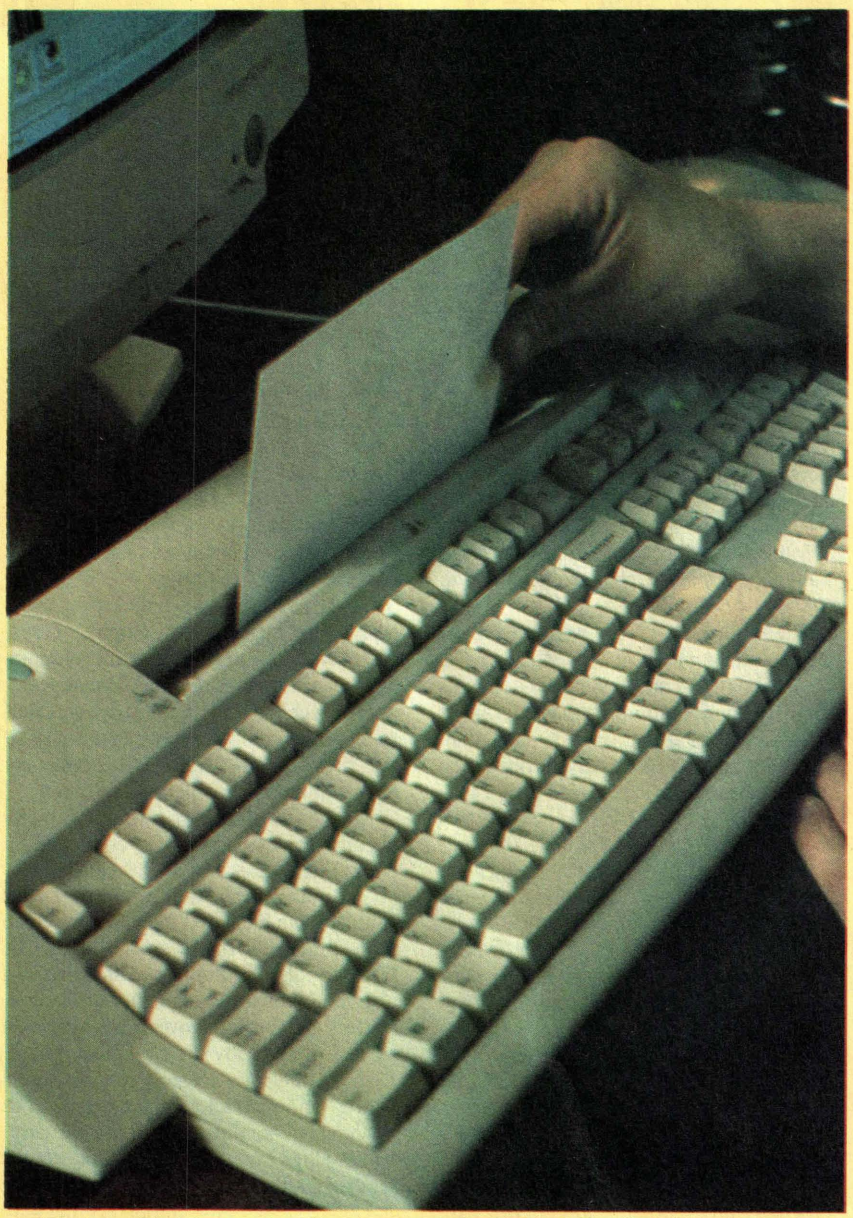
The 9240 is shipped with a wealth of software that tries to cover all the bases. First, of course, is Microsoft's Windows 95. What? You don't like it? Well, you might as well get used to it! Actually, Compaq provides two alternatives: The Compaq Activity Manager, and Launch Pad.

The Activity manager is a shell for Windows 95 that isn't all that bad. But we don't really see any intrinsic benefit over learning how to use Windows. A first-time user might find it easier to launch applications from the Activity Manager, but we would hate to see what would happen when he or she tried to install a new program.

Launch Pad is more sensible—it's an interface specifically for kids. We have no idea whether kids will actually like it, but that's not the point. Launch Pad serves as a way to keep kids out of *our* stuff if they don't have the right password. Launch Pad can be configured and customized for multiple little users.

The Presario 9240 also contains a bundle of productivity software. First is *Novell PerfectWorks*, which is a suite of applications that includes word processor, spreadsheet, database, drawing, and paint programs. We personally prefer *Microsoft Office*, but *PerfectWorks* is a more-than-capable contender.

Gold Disk's *Astound CSE* is provided to create multimedia presentations. Quicken's Special Edition is provided for money management.



The scanner keyboard is one of the unique features of the Presario 9240. It hasn't created a paperless office for us yet, though.

Compaq's *MediaPilot* software controls not only the CD and audio system, but also the telecommunications system, including an address book. The Presario 9240 has a full-featured, full-duplex speakerphone. Software includes *SpeechMail*, a voice-recognition package. It allows people to leave messages in any configured mailbox by simply speaking the name, or to listen to messages just by speaking the command—play next message, repeat, erase, etc.

Any computer that finds itself in a home is going to be used at least part-time as a game machine. Supplied on CD-ROM are *Descent Destination Saturn*, an action game; *Hardball 4*, a baseball game; and *Magic Carpet*, which is some kind of kid's game—but we're not really sure because we were never able to get it to run.

Reference CD-ROMs include *Compton's Interactive Encyclopedia 1996, The Family Doctor* (Creative Multimedia), *The Face of Life* (Magazine, that is), and *My First Incredible Amazing Dictionary* (DK Multimedia).

Interestingly, the CD-ROM applications aren't loaded on the hard disk; they must be installed manually before they're used. Fortunately, the documentation that describes the installation process is very well done, so users will end up learning typical installation procedures when they want to use the software.

Online software applications on the hard disk include America Online, Prodigy, CompuServe, Global Network Navigator, Reuters Money Network, the ImagiNation Network, Charles Schwab StreetSmart, and Dow Jones Personal Journal. All have trial subscriptions. Netscape Navigator V1.22 is also provided for browsing the Web.

Additional applications loaded on the hard disk include *Gift Maker* (Maxis), *Rand McNally TripMaker Special Edition, SimCity Classic*, and *Widget Workshop.*

Backup diskettes are not provided for any of the pre-loaded applications. When you turn the machine on, you are periodically prompted to make a set of backup diskettes. The thought of swapping through thirty diskettes was enough to make us put it off—until it was too late.

We loaded some older software (Compton's NewMedia's *Jazz: A Multimedia History*) that overwrote some of Window's multimedia drivers, and basically made our system unusable. We spent hours trying to get things back to normal. Fortunately, we had Windows 95 on a CD-ROM—otherwise, we would have been sunk. All in all, it is incomprehensible that Compaq does not include a backup CD-ROM that would allow you to restore the PC to its original state in the event of a catastrophe (or even a simple mistake). Yes, we could have avoided the problem by

making the backup diskettes. But those 30 diskettes would cost us more than it would cost Compaq to press a CD-ROM, like most mainstream computer manufactures do. Worse yet, the press materials we received indicated that a QuickRestore backup CD was to be included. That means that Compaq didn't leave it out because of ignorance—they made a conscious decision to omit it.

Our system was equipped with a Presario 1510 SVGA monitor. It sports a "15-inch" screen with a viewable area of about 13.5 inches. The speakers supplied with the monitor clip easily on its side. They attach to speaker-output jacks (spring-loaded clips) on the rear of the monitor. The monitor, in turn, connects to the PC with two color-coded cables. (All connecting cables for the Presario are color-coded, making setup a breeze even for computer neophytes.) One cable goes to the audio-output jack on the rear of the PC, the other to the microphone-input jack. The 1510 monitor contains a built-in microphone for use with the full-duplex speakerphone and other applications.

The keyboard supplied with our system—normally a $349 option—is the *Scanner Keyboard* sold under the *Compatibles by Compaq* brand. Along the top of the keyboard is a slot for inserting images, drawings, photos, business cards, or anything else you want to scan. *PaperPort* software, from Visioneer Communications, Inc. is provided with the keyboard. We're not really any closer to having a paperless office, but the scanner keyboard is great. First, it really doesn't take up any additional space on the desktop, but it serves not only as a scanner, but a fax machine as well—even a copier if you're in a pinch.

The *PaperPort* software makes it easy to store scans in appropriate folders. For example, we were able to reduce our office clutter somewhat by scanning in articles from some of our favorite trade weeklies, and storing them by subject categories. *PaperPort* supports optical character recognition, so we could choose to save image files, or plain text files. Keep in mind that you don't have to buy a Compaq system to get the keyboard. It's available as a stand-alone add-on for any PC compatible.

As neat as the scanner keyboard is, the Presario has another, even more innovative feature: the PD-CD drive. PC-CD, (Phase-Change Dual, or simply Phase Change Disk) is a new rewritable optical disk format.

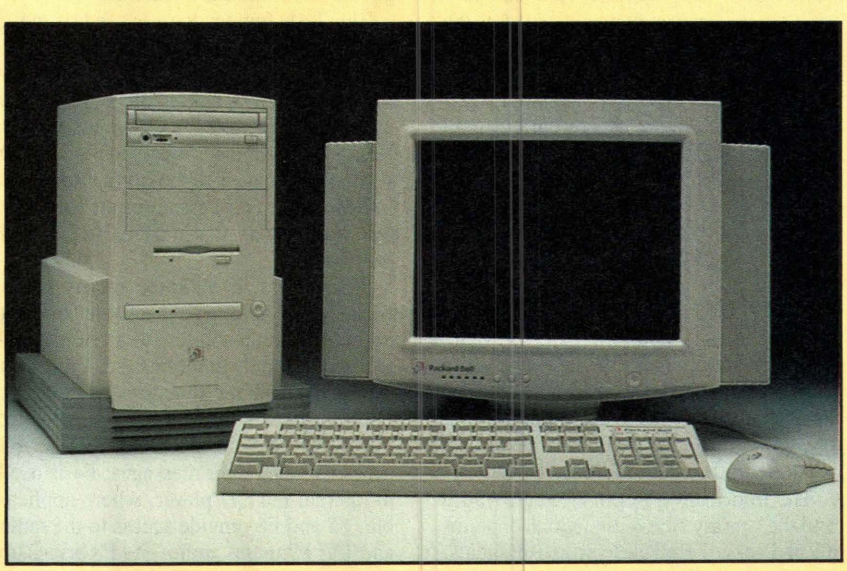
The disks, which store up to 650 megabytes of data, are housed in a special cartridge caddy. The PD-CD drive is actually two drives in one because it can read and write PD-CD disks as well as standard CD-ROMs. It automatically recognizes what kind of disk is inserted. For example, with a PD disk in place, the drive becomes logical drive D: and looks like a standard hard disk to the computer. With a CD in place, the drive becomes drive E:, a 4× speed CD-ROM drive.

PD-CD is a brand-new format, and market acceptance is far from certain. However, we'd bet that it will be a success. Although far slower than a hard-disk drive, the PD-CD leaves backup tapes in the dust. As hard drives get bigger and bigger, some manageable way to back up and store data is essential. PD-CD seems to serve that role remarkably well. New cartridges cost about $30. If they allow you to put off the purchase of an expensive new hard disk, they can actually end up saving you money.

All in all, the Compaq Presario 9240 is an excellent choice for the home, office, or home office. Its one glaring shortcoming is the absence of a backup system CD. Otherwise, it has the power to meet any of your computing needs. ■

Going Platinum

PLATINUM PRO MULTIMEDIA PC PACKAGE. Manufactured by Packard Bell, 1 Packard Bell Way, Sacramento, CA 95826; Tel. 916-388-0101. Street price: about $2700, including monitor.



Packard Bell's Platinum Pro line is representative of today's multimedia PC packages. We tested a Pentium 150-MHz, with 24 MB of RAM, a 2-GB hard drive, a 1.44-MB floppy drive, a 28.8-kbps fax/modem, a 6-X CD-ROM drive, and a 15-inch color monitor. "Extras" include a telephone answering system with full-duplex speakerphone, SRS 3D speakers, 1 MB of video memory (VRAM), MPEG1 full-motion video playback, and a remote control.

The Platinum Pro software bundle is extensive, with more than 40 titles. It features the Windows 95 operating system, as well as Packard Bell's own Navigator interface, intended to help new users overcome any computer phobia they may be experiencing. The Packard Bell Library disc contains systems manuals for on-screen help. Pre-loaded software includes *Quicken Special Edition, Microsoft Works 95, Microsoft Money 4.0*, and *Microsoft Design Pack*.

A large collection of CD-ROMs is also pre-loaded and ready to run when the discs are inserted. For kids, there's *My First Encyclopedia, Spider-Man Cartoon Maker, TuneLand*, and a couple of animated storybooks. Reference materials include *Microsoft Encarta*, a multimedia encyclopedia; *Mindscape Completer Reference Library*, a collection of ten reference books featuring photographs, soundtracks, animation, video, and text; The *Guiness Multimedia Disc of Records*, and the *Sports Illustrated Multimedia Almanac*. In terms of games, you won't find *Myst* or *Doom*, but tamer fare such as *Reader's Digest Multimedia Crosswords* and *The Journeyman Project Turbo*, a "photorealistic adventure game."

When you pull the Platinum Pro out of its box, you'll notice right away that the connections for all the peripherals are color coded. That makes initial setup a piece of cake. (Attaching the speakers, however, is trickier than necessary, requiring the use of a long, thin screwdriver.)

Getting started is also easy, whether you're an experienced Windows user or complete newcomer to computing.

Children and novices might be more comfortable starting out using the Navigator interface, a "virtual home," with software arranged throughout its three rooms: the Living Room, Software Room, and Information Room. You can set up the Navigator so that the room containing the applications you're most likely to use is the room you'll always enter upon start up. You can also opt to bypass the Navigator altogether if you prefer to simply use the standard and more straightforward Windows 95 interface.

The Living Room features the consumer-electronic products you'd expect to see in a real home—a stereo with FM radio and CD player; a TV; a telephone, speakerphone, answering machine, and fax machine; and a clock—and some you probably don't have in your house—a WAVE player, a MIDI player, and a media controller. (Packard Bell does offer PCs that include TV and FM radio receivers, although our test model did not contain them.) By clicking on one of the realistic graphic representations, you can enter that application directly. Select the CD player, for instance, and you'll get an on-screen control panel from which to select play, pause, and track number. You can also send faxes, answer phone calls with the built-in speakerphone, and send and receive faxes using the icons found in the Living Room. Advanced telephony features allow you to set up multiple mail boxes, send faxes automatically, and even call your beeper when a call or fax is received.

If you click on the door at the right side of the Living Room, you'll move into the Software Room. Its bookshelves are filled with all of the Platinum Pro's pre-installed software titles, arranged in categories. Select a category to make the titles appear on the shelves, and then click on a title, and insert the disc if needed, to run that application. You can easily add your own software to the existing titles.

The Information Room is where you'll find the Library Bookcase, which contains all of Packard Bell's electronic manuals. The Tutorial Gallery provides access to multimedia lessons on such subjects as "Getting Started" and "Software Basics," taught by a video narrator using animation and colorful graphics. Another set of bookshelves holds icons for all of the available online services and electronic documentation. The Platinum Pro provides direct access to the Internet and to Prodigy, America Online, and CompuServe. You'll find demonstrations and explanations of the costs of each service in the Information Room. (Special discount offers are included.)

An added bonus with the Platinum Pro is a remote control, which can be used to operate the CD player and some PC functions.

The Navigator provides a host of features to make it easier to find your way around all the applications available to you. The InfoGuide, found in all three rooms, allows you to click on any icon to pull up a detailed help screen. By clicking on the Quick Tips icon, you can get helpful advice about the PC's features.

The Task Jumper icon is used to move directly to another application or function, even if you're not sure what it's called or where to find it. Clicking on the icon calls up a list of categories, such as Business or Home Electronics. You can play a CD without going back to the Living Room, or find your word processor even if you can't remember that it's part of Microsoft Works.

Also found in all three rooms is the Menu Key. Clicking on it activates the Fast Media feature, a shortcut to all of the system's multimedia functions. Selecting Fast Media changes the functions of the F1 to F8 keys. F1 will now provide online help; F2, direct entry to the speakerphone; F3 accesses voice mail messages; F4 is used to operate the CD player; where applicable, F5 and F6 provide access to the radio and TV; F7 mutes audio; and F8 brings up the active device's software interface, allowing access to advanced features. Fast Media also turns the arrow keys into volume and selection control keys. All of the Fast Media Functions can also be accessed using the remote control included with the Platinum Pro.

The Navigator's Tool Bar offers several more options for moving around your applications and using all the PC's features. The Media Controller is used to access digital recordings saved in .WAV format ("Wave" files); the musical instrument digital interface, or MIDI; AVI (audio video interleave); the CD player; and the Call Center, which instantly retrieves calls or voice mails. Other tool-bar features can be used to exit to Windows, lock and secure different areas, control volume, and see a list of all the programs currently running on the system.

Some of those same features can be accessed using special keys on the keyboard. There are two Windows 95 keys, located to the outside of each "Alt" key, that automatically call up the main Windows 95 menu when pressed (even when pressed accidentally, we might add). At the top right corner is a key labeled "Fn Menu," which activates the Fast Media option to change the function keys' purpose.

These days, when you buy a computer, you buy a connection to the rest of the world. The Platinum Pro is no exception. Equipped with a 28.8-kbps fax/modem, and connected to your phone line, the system allows you to place and receive phone calls, send and receive faxes, record voice messages, and forward calls to your pager number. The included software makes it easy to use online services and even learn to surf the Net. Packard Bell Internet access features the Spry Mosaic Web browser, e-mail, Usenet, and FTP, which allows users to download files from any Internet site. Seven free hours of access time helps new users get started.

The Platinum Pro also offers a voice-over-data package called VoiceView Talkshop, which allows you to talk and exchange data in a single phone call. When you use VoiceView Talkshop to go "teleshopping" at such online businesses as Blockbuster Music, 1-800-FLOWERS, and American Airlines, you can see their products on your screen and talk directly to sales people. VoiceView Talkshop can also be used for online technical support help, providing what Packard Bell calls a "personal home technician" to quickly diagnose hardware and software difficulties. The interactive support program allows a technician to capture screens; retrieve, set up, and configure files on your system; and correct them over the phone.

Coming from a 486 DX-50 running Windows 3.1, we found using the Platinum Pro was a dream. It took very little time for even the least computer-savvy family members to learn their way around the Navigator interface and Windows 95, discover new favorite programs among the bundled software, and load their old favorites—a speedy task on the 6× CD-ROM drive. We had a glitch or two; the fax machine was picking up our voice calls for the first day. But it was easy to iron things out, without having to resort to calling the tech support lines either the old-fashioned way, or via VoiceView Talkshop. In fact, we barely had to open a printed manual. ■

All for Five, And Five for All

MFC-4500 MULTI-FUNCTION CENTER. From Brother International Corporation, 200 Cottontail Lane, Somerset, NJ 08875; Tel. 908-356-8880. Manufacturers suggested retail price: $995.95.

Home offices are popping up all over, thanks primarily to modern technology. Just plug in a computer, printer, fax machine, telephone, answering machine, modem, and copier; and you're connected to the rest of the world and ready for business.

Problems arise when you get home from Office Max and try to fit all that gear—not to mention your desk, computer stand, file cabinets, bookshelves, chairs, and wastebasket—into a corner of your bedroom, or the tiny spare room that must also house your NordicTrack.

Recognizing the space-crunch dilemma, manufacturers have created a new product category, called multifunction devices (MFD) or multifunction peripherals (MFP). Aimed directly at the SOHO (small office/home office) market, these all-in-one hybrids combine, at minimum, printing, plain-paper faxing, and copying functions. Many also offer scanning and fax/modem features. They not only require less space than all those separate units, but they generally cost less too because the same hardware performs multiple functions. Printing a fax, after all, isn't much different from printing any document.

MFDs make good use of the power and brains of your PC. They typically connect to the computer through its parallel printer port, and use Windows-based software interfaces. Faxes can be printed immediately, stored for later printing, or stored on disk. Speed-dial phone numbers and fax broadcasting numbers can be input using your computer's keyboard, instead of awkwardly shifting and selecting characters from the fax machine's front panel—some models even let you import names, numbers, and addresses from your existing address book in another software program.

Although by definition a multifunction device plays many roles, it often stars in only one. That's because manufacturers generally adapt an existing model of fax or printer by adding more functions. Its original role will surely be its strongest.

The Brother MFC-4500ML is a case in point. Based on the Brother HL-630 printer, it provides high-quality, 300-dots-per-inch (dpi) laser printing at a speedy 6-page-per-minute (ppm) rate. Text and graphics printouts are excellent, cleaner and crisper than that provided by the many ink-jet MFDs on the market in the $1000-and-under range. Although it doesn't slouch in performing its secondary functions of faxing, copying, scanning, and computer faxing via a fax/modem, the MFC-4500ML's forte is printing.

Like the HL-630, the MFC-4500ML uses Brother's proprietary "Straight Paper Path" technology. Rather than passing through a twisted route past a series of rollers inside the printer, the paper travels the shortest route between two points—a relatively straight line between the paper feeder and the output tray. That design has several benefits, including faster output, less paper curling and jamming, the ability to handle a wide range of sizes and even thick paper stock, and fewer parts to break down. (see Fig. 1).

Fewer parts also means smaller overall size—the MFC-4500ML has a tidy little footprint of just 14 square inches. With its front-panel numeric keypad and speed-dial buttons, it most resembles a fax machine. A closer look, however, reveals a horizontal row of function buttons, and two vertical rows of buttons for selecting printer and copier options. A small, two-line display shows the time and date, and provides status reports. Jutting out from the left side of the unit is a telephone handset—which, we suppose you could say, represents this MFD's sixth function.

Connecting the MFC-4500ML to a PC is a relatively straightforward affair. Even those who are technically inexperienced should have no trouble following the step-by-step directions on the included instructional video. It walks you right through the process, showing you how to attach all the paper trays, load the drum and toner cartridge, and make the connections to your phone lines and PC. A separate phone jack is provided for an external telephone or answering machine. Unlike most MFDs, which require only parallel-port connection, the MFC-4500ML must also be connected to the serial port for its Missing Link software interface—and PC faxing—to work.

Missing Link is a Windows-based, graphics interface used to control the fax/modem, printer, and scanner. It lets you program the MFC functions on your PC, instead of using the front-panel buttons. The Missing Link fax drivers can be used within any Windows application that supports printing.

You can use Missing Link to control printing, sending and receiving faxes, and scanning; and also to find, view, and "staple" (attach) documents. But first you'll use it for setting up the MFC-4500ML to meet your specific requirements, using MFC remote setup, "control panel" settings, one-touch/speed-dial setup, and the address book.

MFC remote setup provides a quick, easy way to program the MFC-4500ML, allowing you to download programs from the PC to the MFC, and upload programming from the MFC to the PC for easy editing. It also allows you to set your system for fax forwarding to another number or dialing your pager number. MFC remote setup requires you first to input your name, phone, and fax numbers, as well as the correct date and time. You can opt to have a transmission verification report printed after every fax sent and activity reports printed at certain intervals, to set a

timer for delayed faxing, and provide the information you'll want printed on your fax cover page (including comments). You can also set the beeper volume, change the default time for the unit's energy-saving sleep mode, and change the incoming fax reduction mode from the factory-preset (automatically reduces incoming documents to fit on one page) to one of four fixed reduction ratios. Telephone options include pulse/tone, auto or manual re-dial (for faxing only), speaker and ring volume, and the number of rings before the MFC will answer.

The MFC database allows you to store 24 one-touch numbers and 100 speed-dial numbers for standard—not PC—faxing. You can also create up to six groups of numbers for fax broadcasting—sending the same fax to several people. You can download the database to the MFC-4500ML and, when you later want to make changes or additions, upload it to the PC for easy editing.

Using the MFC-4500ML's fax/modem mode to send faxes from your PC is a simple matter of filling in the information requested in the Fax Send dialog box, and selecting the start button. For fax broadcasting, or frequently used fax numbers, Missing Link provides an Address Book. You can set as many as ten separate Address Books, each with up to 500 entries. Unfortunately, it isn't possible to import names, addresses, phone and fax numbers from any other databases you might already have. But once you've taken the time to input the data, sending PC faxes from your Windows applications is an easy, virtually invisible, procedure.

The fax/modem offers delayed transmission and broadcast functions. The Fax OutBox helps you keep track of your outgoing faxes, showing the status of all unsent faxes and providing a complete activity log of all fax transmissions. That activity log is stored as a file that can be incorporated into other applications, such as a billing program.

When you receive faxes sent to your PC, your regular computer activity is not interrupted. The faxes are sent directly to your Missing Link InBox, which provides for electronic filing and indexing of faxes, maintains a log of incoming faxes, and prints out collated copies of multiple-page faxes. You can opt to view a fax on screen, store it, or print it.

Files you've scanned or faxes you've created using the Brother MFC-4500ML Missing Link—called Brother files—can be manipulated in various ways that will make the home-office worker's job a little easier. Brother files are compressed, multiple-page, black-and-white images, with a maximum image size of 8.5 inches wide by 14 inches long. Missing Link can easily scan, display, locate, print, and fax those files, which occupy a minimum of disk space and can be converted to other file formats.

Selecting the MFC Finder icon allows you to locate files in a few different ways. It's possible to browse through files and directories, perform keyword searches using a freeform description in plain English words or phrases, or search using the date the document was last changed and a portion of the document name. When you find the Brother file you were seeking, you can view, print, or fax it directly from the Finder.

To view, edit, print, and fax Brother document images, the Viewer is used. The Viewer allows you to immediately see all or part of your document on screen; scale and rotate your view of the document; move, delete, or add pages to a file; use the Windows Clipboard; and import and export images from and to other popular image formats, including Windows Paint.

The Missing Link interface also controls the MFC-4500ML's scanning functions. By selecting the ScanFile icon, you can directly input text and image documents into your PC, and add a written description (up to 127 characters) of the document. Multipage documents are saved as a single DOS file, making it easy to attach them to e-mail files and other Windows applications. Double-sided originals are automatically saved in the proper order. A batch of documents can be scanned at the same time, yet stored separately, by inserting blank separator sheets between each document. Or, if each document has the same number of pages, select "equal number of pages," and the machine will automatically separate them. You can adjust the contrast and resolution, and select Line Art for text, graphics, and black-and-white printed materials, or "Photographs" for photos and colored materials.

While you are scanning a batch of documents, you needn't stop your regular work—even if your work directly involves another MFC-4500ML function. The unit's dual-port design allows you to print documents through the parallel port while scanning, faxing, or copying another document via the serial port connection.

In its copier mode, the unit will print from one to 99 copies of each page. You can insert a stack of paper for copying multipage jobs, and the pages emerge in the right order—which is not the case for many of the unit's competitors—although it can't collate multicopy, multipage jobs. Four copy reduction sizes and three copy enlargement sizes are offered. Three resolutions include fine and superfine for text jobs, and photo for photographs and other graphics.

The MFC-4500Ml truly stands out from the under-$1000 crowd. ■

YOU'VE COME A LONG WAY

(Continued from page 21)

monitor is non-interlaced, which means that every line on screen is refreshed and redrawn at every pass, reducing annoying flicker.

Printers are also sold separately in most cases. Laser printers provide the best quality and speed, at the highest prices. For many personal applications, an ink-jet printer may be sufficient.

Also not included—but certainly a worthwhile investment—is a backup system on which to store information for safekeeping in the event of a system crash.

Finally, you'll want to hedge your bets against obsolescence by ensuring that your PC can be upgraded as needed. It should have extra serial ports for devices such as modems, mice, and scanners, and parallel ports for printers. And there should be several extra slots inside for adding expansion cards.

That's it for the "basics"—what a difference a few years make! Today, the bells and whistles could include TV and/or FM radio cards, which let you watch your favorite shows and listen to the radio on your PC; a remote control to operate those consumer-type functions, as well as some PC functions; and video accelerator cards or extra VRAM (video RAM) to speed up the movement of video images.

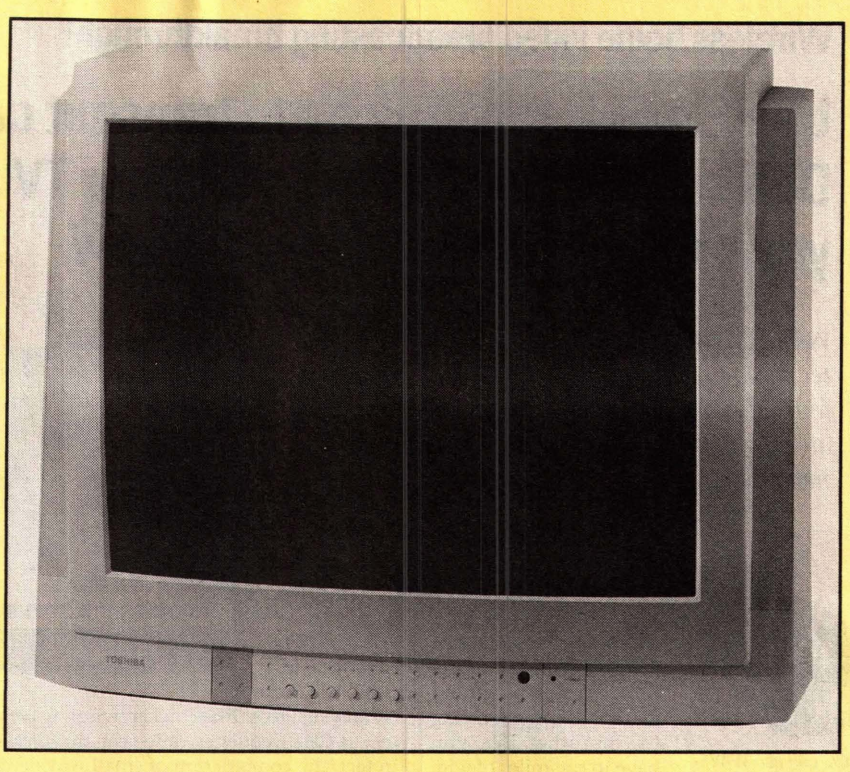
What can you expect to pay for a PC package today? Prices vary widely by configuration and by dealer. We checked out the flyers tucked into this Sunday's paper, and found some of the following prices: A Pentium 166 from Digital, with 16 MB RAM, a 1.6-GB hard drive, 4× CD-ROM drive, 16-bit Sound Blaster-compatible sound, and 28.8 kbps fax/modem was advertised for $2099.95 at a local discounter, which was also offering an NEC 120-MHz Pentium with 16-MB RAM, 6× CD-ROM drive, 16-bit wavetable surround sound, and 28.8-kbps fax/modem for $1799.95. Each came with a "large software bundle" but no monitor. A home-office super center was selling the exact configuration of Packard Bell that we review below for $2599 including the monitor—and with a Hewlett-Packard inkjet printer thrown in for just $99 more. And a local consumer-electronics chain had an IBM Aptiva 150-MHz Pentium with monitor, 16-MB RAM, a 1.6-GB hard drive, 6-X CD-ROM drive, and 28.8-kbps fax/modem for $2749.96—$350 off the usual price of $3099.96.

LET'S SEE WHAT THE FUTURE BRINGS

If there's any industry that undergoes change faster than the computer industry, we're not aware of it. New, faster CPUs,

are announced every few months, followed by price drops for older ones. Even the PC itself might be changing fundamentally, as low-priced Internet access terminals are being proposed by several manufacturers. PCTVs, devices that combine both computer and television functions, are also beginning to hit the streets. High-speed modems that operate over cable-TV wires are sure to accelerate the process.

But that doesn't mean you should put off your PC purchase because of fears of obsolescence. There's never been a better time to buy a PC than today. ■



Monitor Your TV

TOSHIBA INTEGRATED MULTIMEDIA MONITOR, OR TIMM. Manufactured by Toshiba America Consumer Products, Inc., 1010 Johnson Drive, Buffalo Grove, IL 60089; Tel. 800-253-5429, ext. 397. Suggested retail price: $999.

There's no question that the line between the computer and consumer-electronics industries is blurring. In fact, next spring in Atlanta the two industries' largest trade shows—Comdex and the Consumer Electronics Show—are being held simultaneously in Atlanta. And many of the products that will be shown there are hybrids that could belong at either show.

There are television cards for your PC, and Internet access devices for your TV. Televisions and telephones are used for banking and shopping. Computers, equipped with sound cards, speakers, and CD-ROM drives, are used for entertainment and listening to CDs. Gateway's Destination PCs feature 31-inch screens and television tuners—definitely meant for the living room, not the desktop! RCA is test marketing a 35-inch TV that comes with a CD-ROM player and a modem, while Zenith's NetVision line of 27-inch and larger TVs will be Internet-ready.

Toshiba was ahead of the game when it introduced TIMM—the Toshiba Integrated Multimedia Monitor—early last year. With its 20-inch screen, TIMM serves as both a computer monitor and a television set.

Of course, not everyone needs a TV in the home office. Most of us can get the work day started without the help of Regis and Kathy Lee, and can make it through the afternoon without a dose of the soaps.

TIMM, however, is not being marketed as a home-office tool. Instead, it is intended for use in information kiosks, trade show booths, and interactive point-of-purchase displays—and maybe the occasional dorm room. It can also replace the old-fashioned overhead projectors in modern conference rooms, paving the way to visually exciting computer presentations and video programs.

There just might be a home market for TIMM—not for work, but for play. Videogamers will delight in the ability to back off a bit from the screen as they play their favorite games in large-screen style. It's a bit pricey, but not much more than today's 17-inch monitors. And when they're not playing games, they can still use TIMM for watching TV, video, or laserdiscs.

For TV viewing, TIMM features a 181-channel, cable-ready receiver with closed captioning. The VGA-compatible monitor hooks up directly to DOS-based PCs, although an adapter is needed for connection to Mac II computers. Composite and S-video jacks make it easy to connect a VCR, or laserdisc player.

TIMM's picture is bright enough for television viewing, yet clear enough for computer work. An Invar shadow mask allows operation at the higher voltages needed for brighter picture quality without loss of color purity or sharpness, even in the corners.

TIMM offers VGA-quality resolution of 640 × 480 pixels—not up to par with SVGA monitors. But for its intended applications of conference presentations, kiosks, and video gaming, TIMM won't be used as close up as would a desktop computer monitor. Toshiba claims that at that added distance, VGA is sufficient.

As for television watching, TIMM's performance is top-notch. It offers 500 lines of horizontal resolution; laserdiscs produce a resolution of 425 lines, and that's more than you'll get from videotapes or even CD-ROMs. The distance between pixels, or dot pitch is 0.58 mm, which Toshiba claims is a 36% finer pattern than is found in most 20-inch television sets—but that, too, is not up to par with SVGA monitors.

Sound is an important aspect of games and business presentations, and TIMM is up to the task with its built-in 10-watt audio system. The high-performance speakers in the unit, which are suspended in a tuned horn structure, improve signal separation and enhance full-frequency performance. The monitor also features a bass-boosting Sub Bass System circuit, as well as an MTS stereo decoder with SAP and dbx noise reduction.

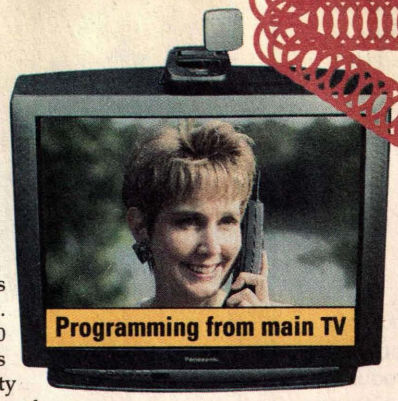
TIMM is also the first multimedia monitor to come with a remote control. The remote can be used to operate all TV functions, and also to control several computer-related features. For instance, if you do need to use TIMM for close-up work—word processing or creating spreadsheets, for instance—the large screen size can be somewhat overpowering. The remote can be used to expand or contract the image either vertically or horizontally for comfortable viewing.

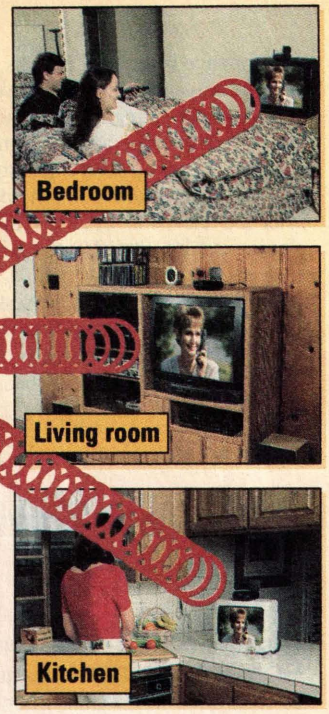
Although it is a well-made, well-though-out product, TIMM has been having some trouble finding its niche, particularly in the home market. It won't be "the next VCR"—but TIMM just might be the forerunner of a new, exciting, consumer technology, the PCTV. ■

Wireless home video broadcasting breakthrough!

Use 2.4 GHz technology to transmit cable, DSS and VCR signals to any other TV in your home...*up to 300 feet away!*

WAVECOM Jr., from RF-Link, uses 2.4 GHz technology, circularly polarized transmission, four channels and FM to broadcast stereo audio and video signals with clarity never before available.





You can use WAVECOM Jr. with your:

- ✔ Cable TV
- ✔ Camcorder
- ✔ Computer
- ✔ Digital video disk
- ✔ Laser disc player
- ✔ Network TV
- ✔ Powered speakers
- ✔ Satellite (DSS)
- ✔ Security camera
- ✔ VCR movies
- ✔ Wireless cable

If you are like most people, you probably own more than one television and subscribe to cable or satellite programming. But in order to extend that special programming to your other TVs, you have to run miles of wire and/or pay for the additional connection. Isn't there a better way?

Watch TV on more than one set. New wireless home video broadcasting technology found in WAVECOM Jr. from RF-Link can transmit signals from cable, digital satellite system (DSS), even a VCR, from a video source (your main TV) to other TVs in your home, office or school without sacrificing picture or sound quality. You can even use it to transmit between your TV and computer, without wires or connection fees!

Introducing WAVECOM Jr. WAVECOM Jr. heralds in the latest in wireless transmission with 2.4 GHz technology. This new frequency is superior to 900 MHz in several ways: the most important benefit of the 2.4 GHz range is that it is totally uncluttered. WAVECOM Jr. is one of the very first products to utilize this frequency, enabling it to deliver consistently sharp stereo audio and video signals, through walls and ceilings, up to 300 feet away.

2.4 GHz circular-polarization technology. For years, the most advanced wireless products have boasted the use of the 900 MHz frequency using linear transmissions. But linear waves can be blocked by studs or other hidden barriers within your walls.

However, WAVECOM Jr.'s. 2.4 GHz technology uses a circular polarization signal to give you crystal-clear, powerful re-transmission of audio and video signals throughout your home, unobstructed by walls, ceilings or floors. Even if there is a wall stud in the path of the signal, virtually all of the wave is still free to pass to your television.

In addition, as signals get higher in frequency (from 49 MHz to 900 MHz to 2.4 GHz), the wavelengths get smaller. So where 900 MHz waves have difficulty passing through certain surfaces (like chicken wire), waves in the 2.4 GHz frequency range can do so easily. In fact, the combination of small wavelength size and circular polarization transmission means that there is virtually no obstacle that WAVECOM Jr. cannot overcome.

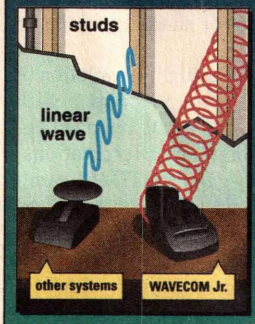
It's FM, not AM. WAVECOM Jr. uses FM to transmit signals, not AM, for the same reasons that FM stations are superior to AM stations. High-gain directional transmitting and receiving antennas are used, instead of omni antennas, to minimize interference from unwanted signals and inherent problems of *multipath* (a phenomenon where transmitted signals bounce around and create "ghosting").

THE WAVECOM ADVANTAGE

■ **2.4 GHz transmission.** This brand-new, uncluttered frequency provides more clarity than ever thought possible in wireless home broadcasting systems.

■ **300-foot range.** The WAVECOM Jr. transmitter can broadcast clearly to multiple receivers, through walls, ceiling and floors...up to 300 feet away!

■ **High-gain directional antennas.** The antennas on both the transmitter and receivers are directional—turn them to the left or right, aim them upwards or downwards to create a seamless link.



■ **Circular polarization.** WAVECOM Jr. utilizes circular polarized waves. Unlike linear waves, circular waves can pass through walls—*and the hidden obstacles within the walls*—unlike any other system.

Not even hidden studs can stop WAVECOM Jr.!

Exclusive features. One of WAVECOM's key features is the use of four channels for interference-free channel selection, which makes it arguably the most superior home video broadcasting system available. In many uses, up to *four channels* can operate simultaneously. This feature can be very useful for private and civil surveillance systems. It also facilitates using your existing camcorder to monitor babies, children and the elderly within your home or yard.

Last but not least, WAVECOM Jr. provides *stereo sound* with independent left and right audio channels. This enables you to hook up wireless powered speakers to your CD or cassette player. All total, WAVECOM Jr. from RF-Link is the solution to the dilemma posed by modern TV programming options. You can finally reap the benefits of your premium services throughout your entire home...simply, wirelessly and affordably!

Try it risk-free. WAVECOM Jr. is backed by Comtrad's exclusive risk-free trial. Try it in your home! If you're not completely satisfied, simply return it within 90 days for a full refund, "No Questions Asked." WAVECOM Jr. is also covered by a 90-day manufacturer's warranty.

WAVECOM Jr. System ..... **$199** $16 S&H
System includes one transmitter and one receiver.

Additional receivers ..... **$129** $12 S&H

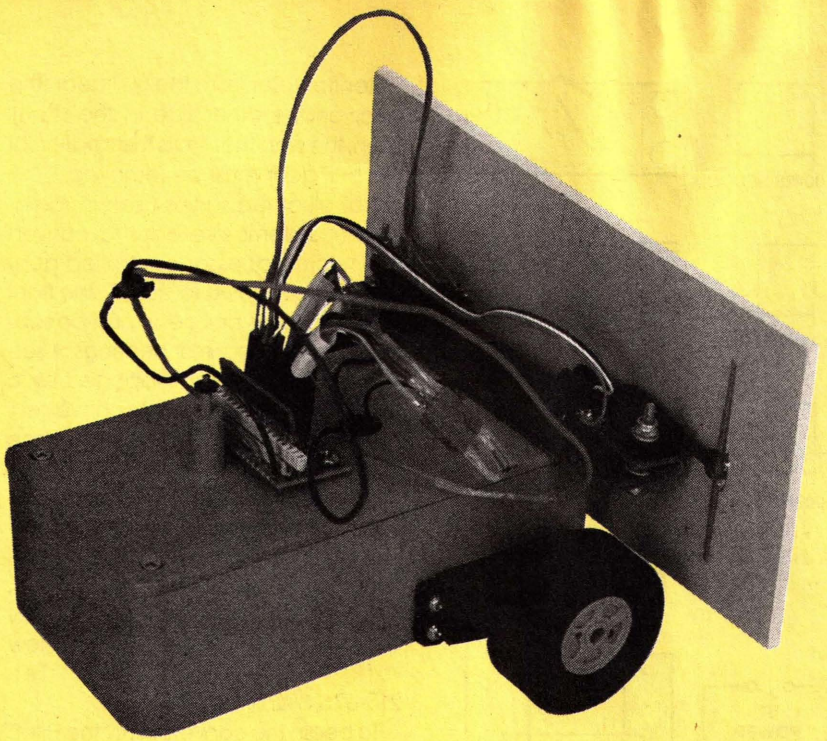
Please mention promotional code **1761-PL-6666.**

For fastest service, call toll-free 24 hours a day

800-992-2966

To order by mail, send check or money order for the total amount including S&H (VA residents add 4.5% sales tax). To charge it, enclose your account number and exp. date.

comtrad industries
2820 Waterford Lake Drive, Suite 102
Midlothian, VA 23113



BUILD A MOBILE ROBOT

This fully programmable robot never gets stuck in a corner, and could be modified to do a whole lot more.

BY MIKE O'CONNOR

Building a mobile robot used to be a major undertaking. Early robotics hobbyists had to build everything from scratch, assembling logic gates, timers, and other discrete components into dedicated controllers. Then came the advent of custom microcontroller-based systems, which presented their own problems; mainly, hobbyists had to program in assembly language while struggling with primitive development tools.

But the struggles faced by those robot builders were not the only drawbacks to the hobby. The resulting creations were usually quite bulky, and not to mention expensive. It took a good-sized robot to haul around an early controller board—electric wheelchair motors and motorcycle batteries were common components. And while the early pioneers put a lot of effort and expense into their robots, if one of their robots malfunctioned it could knock holes in your house!

Now it's much easier and less expensive to build a robot. The advent of small, affordable microcontroller boards and the constant price reductions in servos brings robotics within the reach of more people. While even simple, programmable robots used to approach a thousand dollars in cost, you can build the *Mobile Robot* described in this article for about $100.

The programmable Mobile Robot uses two converted servo motors to get around. Each servo drives a wheel to provide differential steering; in other words, the Robot steers like a tank. Two bumper switches and a short program give the Robot simple reflexes to turn away from obstacles. Once you get your unit running, you can experiment with more sophisticated software and add new sensors.

The BASIC Stamp. Part of what makes the Mobile Robot such an affordable project is its "brain": Parallax's BASIC Stamp. That component opens embedded systems development to new groups of people. It's no longer necessary to learn assembly language, as the Stamp runs a simplified version of BASIC with many features that make it suited to robotics. Called PBASIC, the language supports logical operations, integer math, branching statements, and subroutines. With special-purpose statements, the Stamp can debounce buttons, send and receive timed pulses, and perform serial communication.

As we'll deal with later, writing programs for the Stamp is made simple using Parallax's editor/downloader software. That eliminates the need for a special programmer, emulator, or UV eraser. Programming is as simple as entering a program (either one you write or one of the ones listed later) into your PC, connecting the Stamp to the computer with a special cable, and downloading the commands to the Stamp.

The BASIC Stamp uses a Microchip PIC microcontroller running at 4 MHz. It has eight pins that can be used for input or output, and a 256-byte EEPROM that can hold up to 100 program statements. Fourteen bytes of RAM are available for variables, while additional data can be stored and retrieved from unused portions of the EEPROM.

Servo Basics. Tiny microcontrollers like the BASIC Stamp are only part of the reason why robots have gotten smaller—radio-control servo motors are the other part. Those compact, durable, and inexpensive motors are perfect for small robots, as their control and power electronics are already built-in. One output line from a microcontroller can drive a servo in either direction. What's more, a servo's low speed and high torque makes it better suited to robots than the high speed and low torque of most toy motors.

The Hitec servos specified for use in the Mobile Robot are controlled by pulse-width modulation. A control pulse is sent to a servo about 50 times a second; that pulse varies between 0.00075 and 0.00225 seconds. (For other brands of servos, Airtronics for example, the pulse varies from 0.00100 to 0.00200 seconds.) The position of the servo's output shaft corre-

sponds to the duration of the pulse. For example, a 0.00075-second pulse will cause the shaft to rotate to the limit in one direction while a 0.00225-second pulse will cause rotation to the limit in the other direction. A 0.0015-second pulse will cause the servo to move to the center (see Fig. 1).

The shaft on a regular servo motor has a limited range of rotation and can't rotate through a full circle. Therefore, a robot couldn't travel very far with stock servos. The servo must be converted into a gear motor; such a conversion allows the shaft to rotate freely. But more on that later.

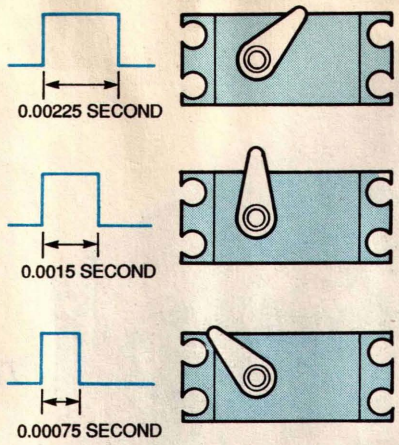


Fig. 1. Using pulse-width modulation, it is possible to control the movement of a servo.

Circuit Description. The schematic for the Mobile Robot is shown in Fig. 2. As you can see, the parts count is extremely low. Power for the circuit is supplied by a 4.8-volt source (B1) that is made up of four 1.2-volt NiCd batteries in series; S1 is the power switch.

The bulk of the circuit's functions are carried out by the BASIC Stamp module, MOD1. That module can interface with a PC through the PCI, PCO, and GND pins, which are connected to header H1. The pin numbers shown next to H1 correspond with the pin numbers of a PC serial port.

Four of MOD1's eight signal pins are shown. Through those pins, the Stamp module can interface with the servo motors and bumper switches of the Robot. Pin P0 connects to servo-motor MOT1, and pin P1 goes to servo-motor MOT2. Bumper-switches S2 and S3 are connected to pins P6 and P7, respectively.

Now, how do those components work together? That depends on how the Stamp is programmed. Later we'll take a look at two different programs that can be used with the circuit. But before you can instruct the Robot, you have to build it. Let's examine how to do that next.

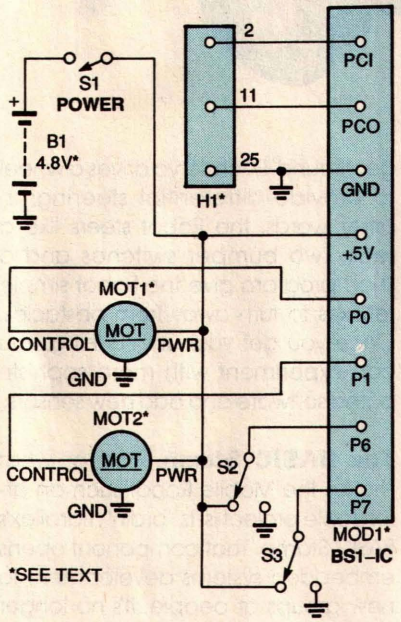


Fig. 2. Here's the schematic for the Mobile Robot. Thanks to the BASIC Stamp Module, MOD1, parts count is kept extremely low. Header H1 makes it possible to interface with a PC for programming purposes.

Construction. The author's prototype for the Mobile Robot was built using a modular design. In other words, the components of the unit were connected to each other with headers and connectors for easy removal and modification. If you plan on maybe adding more sensors to your Robot, or modifying it in some way, you should consider making connections in the same manner. Also, that approach lets you save money by using the same Stamp and servos in different robots.

Now, we'll examine how to build each of the modular components of the Mobile Robot. Because MOD1 connects to all the components, that aspect of the electrical assembly will be dealt with last.

Servo Conversion. As mentioned earlier, before a servo can be used in the Robot it must be converted to a computer-controlled gear motor. That requires two steps: First, it is necessary to mechanically disconnect the potentiometer from the bull gear (the gear on the other side of the shaft). Then, the stop that limits the rotation of the bull gear must be removed.

Not all of the servos used in radio-control systems are easy to convert into microprocessor-controlled gear motors. For a servo to qualify, the front and back of its bull gear must be supported by the case or bearings. A servo with its bull gear supported by a potentiometer is not easily converted. The Hitec HS-425BB specified in the Parts List (see Fig. 3) is an easy-to-convert servo (the standard Hitec HS-300 is difficult to convert), and it is recommended for this project. If you can't find the HS-425BB servo locally, you could order it from America's Hobby Center (146 West 22nd Street, New York, NY 10011-2466; Tel. 216-675-8922).

To begin the conversion of the Hitec servo, remove the four screws that hold the servo together (but keep the bell crank or disk on the servo). Carefully remove the top cover, which will pull the bull gear off the potentiometer shaft. Then, gently remove the plastic clip from the potentiometer shaft. Align the shaft so the raised portion points lengthwise on the servo (see Fig. 4). In other words, the long sides of the shaft should be parallel to the long sides of the servo.

Remove the disk or bell crank from the bull gear and take the bull gear out of the cover. Use a hobby knife to chip the stop tab from the bull gear. Figure 5 shows two bull gears; the one on the left (with the bearing) has had its tab removed. Next, brush away any plastic crumbs from the gear train and reassemble the servo as shown in Fig. 6.

PARTS LIST FOR THE MOBILE ROBOT

MOD1—BS1-IC BASIC Stamp
MOT1, MOT2—Modified servo motor, Hitec HS-425BB or equivalent (see text)
S1—SPST switch
S2, S3—SPDT microswitch
B1—4.8-volt battery (four 1.2-volt NiCd batteries in series)
H1—3-pin header
Perforated board, enclosure, wheels, slide or caster (see text), bumper material (see text), electrical connectors (optional), 14-pin SIP socket, wire, solder, hardware, etc.

When the potentiometer is disconnected from the bull gear, the output shaft is free to rotate continuously. The speed and direction will depend on the duration of the control pulse. A stream of 0.00075-second pulses causes the shaft to rotate at full speed in one direction, while a series of 0.00225-second pulses produces full-speed rotation in the other direction (see Fig. 7).

There are two conditions that will stop the shaft. Those are either when the microcontroller stops sending pulses or sends stop pulses. A stop pulse corresponds to the pulse that would produce the current potentiometer position if the potentiometer was still connected to the bull gear. Because the position of the disconnected potentiometer shaft will be different for each servo, you need to determine the duration experimentally. If the potentiometer shaft is centered (as explained earlier), the pulse width should be around 0.0015 seconds. As the pulses approach that duration, the rotational speed of the shaft will decrease. The Robot can therefore achieve a crude form of speed control by adjusting the pulse durations fed to the servo motors.

When you have finished converting a servo, repeat the procedure with another one so that you create two gear motors. Then, if you wish, attach the three leads of each to some type of three-pin connector to facilitate easy connection of the motors to the rest of the Robot circuit. Again, using connectors and modular assembly is not necessary. You could simply solder the leads to the circuit later on.

Fig. 3. Here's one of the Hitec HS-425BB servos used in the author's prototype.

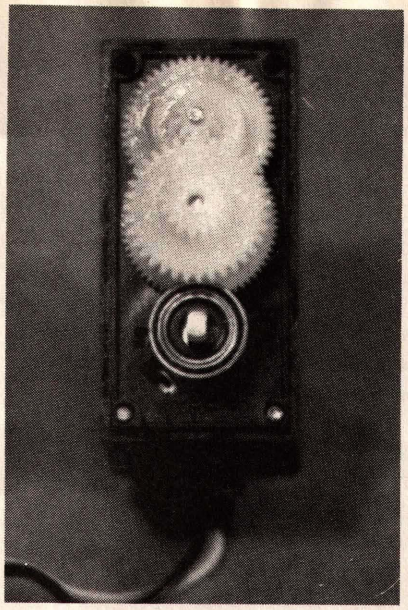


Fig. 4. The servo geartrain is shown here, with the bullgear removed. Note that the clip is off the potentiometer shaft and the shaft is aligned lengthwise.

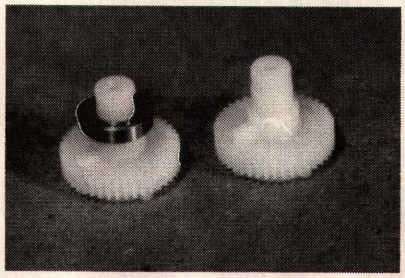


Fig. 5. The bullgear on the left (with the bearing) has had its tab removed, while the bullgear on the right is unmodified.

Mobile Assembly. The gear motors you just prepared need two more things to make them useful for locomotion: wheels and, of course, something to move (the Robot's body). Because the types of wheels used depend on the type of enclosure the Robot is built into, we shall consider the latter first. The author's prototype was assembled using a plastic project box for a frame. Project boxes make great robot enclosures because they are inexpensive and available from most electronics suppliers.

Whatever body you choose for your Mobile Robot, prepare it as follows: Cut openings in the sides for the gear motors (they should be placed towards one end of the enclosure, as shown in the photo of the Robot located elsewhere in this article). Then pass the motors through, marking the positions of their mounting holes on the enclosure. Remove the motors next, and drill mounting holes for the servos. Install the motors at this point.

The next step is to select two matching wheels. Make sure they provide sufficient traction to move the Robot and operate its bumper switches. The latter condition is important because if the switches do not press hard enough against obstacles, the Robot will not know they are present, and will spin its wheels oblivious of the fact that it's not going anywhere (more on the bumper switches later).

Also, the diameter of the tires must be large enough to provide adequate ground clearance. The wheels can come from a variety of sources including toys, RC cars and planes, and even lawn and garden equipment. Just keep in mind that larger wheels will make the Robot roll faster because it will travel farther for each revolution of the wheel.

Whatever type of wheel you choose, it's a good idea to drill a hole in the center that's large enough for the disk-mounting screw to fit through. That makes it easier to remove the wheels. You could attach the wheels to the servo disks with screws and aircraft lock nuts, or you can permanently attach them with epoxy or super glue. You might find that the standard disks that come with the servos are too large for some wheels; if that's the case, you can usually buy smaller disks from the source that supplied you with the servos.

When the wheel-and-motor assemblies are ready, mount them to the openings you made earlier. Then, cut an opening in the top of the enclosure so that you can pass the wires from the servos out to the top.

While we're on the subject of mounting wheels to the enclosure, it is relevant to mention the following important fact: To maximize traction, you should keep most of the weight in the Robot over the wheels. An easy way to accomplish that is to mount the four-AA-battery holder over the servos. That provides adequate traction and prevents the Robot from being easily flipped over. However, if you use large-diameter wheels you might want to mount the batteries under the servos, as you don't want the Robot to become top-heavy.

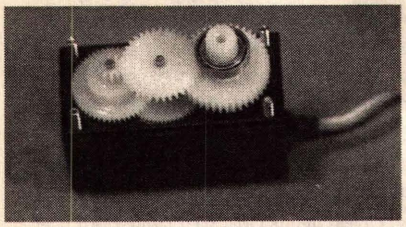


Fig. 6. When the geartrain is reassembled, the bullgear is placed on the potentiometer shaft and the middle gear is once again in the correct position, as shown here.

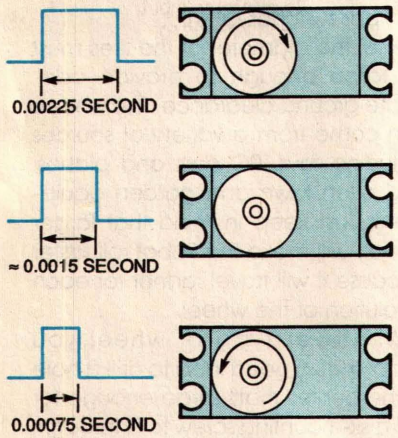


Fig. 7. On a modified servo, pulse-width modulation controls complete circular motion.

If you decide to use the battery pack for traction, mount it at this time. Wire power-switch S1 in series with the positive lead, cut an opening for the switch, and drill mounting holes for it. Then, either attach a connector of some type to its leads, or solder the leads to the rest of the circuit later. Pull those leads through the hole you cut in the top of the enclosure.

Even though most of the weight is carried by the driven wheels, something must support the other end of the mobile assembly. If it's only going to run on smooth, hard surfaces like wood or vinyl floors, the simplest solution is to use a drawer pull or half a ping-pong ball as a slide. For carpets, a small, free-rolling, free-spinning caster is ideal (you might have to search through a few hardware stores to find a suitable one). Keep in mind that such casters occupy a lot of the Robot's volume (Fig. 8 shows the caster that is mounted in the author's prototype). But whatever you use for the third support, be sure it won't cause the Robot to damage the floor or carpet.

Bumper Switches. With the Robot's mobile assembly completed you can now turn your attention to its sensors—the bumper switches. All the information the Mobile Robot receives from the environment comes from those switches. Even if you add more sophisticated sensors at a later time, the bumper switches will always remain the sensor of last resort. Any obstacle missed by sonar or IR range finders, for example, must be detected by the switches.

The most important requirements for the bumper switches used in the Robot is that they have a light activation force, yet still be able to withstand the impact of hitting an immovable object. Ordinary microswitches are more than adequate for a small, relatively slow robot like this one.

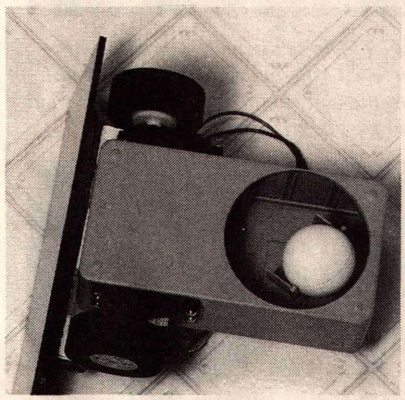


Fig. 8. The caster used in the author's prototype occupies about half the volume of the enclosure.

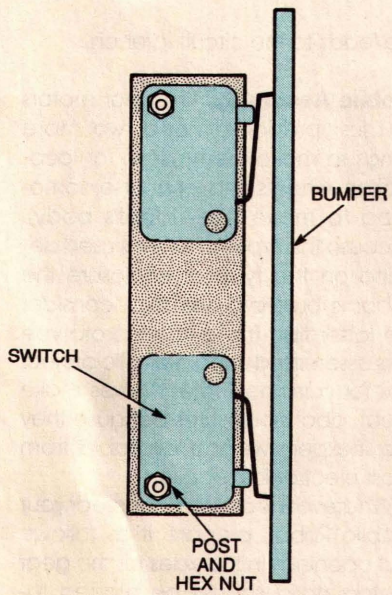


Fig. 9. Here's an overhead diagram of the bumper-switch assembly. The switches pivot on their mounting bolts when the bumper is hit.

Figure 9 shows an overhead view of the bumper switches. Use a single post and hex nut to mount each switch either to the enclosure itself, or to a separate piece of plastic that you can then mount to the enclosure. Position the switches approximately three inches apart.

Next, you must create a bumper from a sheet of plastic, wood, masonite, or foam-core art board. It should be the widest part of the unit to ensure that it hits any obstacle before the Robot's body does. Match the size of the bumper to the obstacles the Robot will encounter. A simple beam or bar can detect walls and the sides of large objects. However, you'll need a bigger bumper if your Mobile Robot will face a combination of small and over-hanging objects.

Once you've selected a bumper, hot-glue it to the switches. Make sure the switches pivot on the posts when the bumper is hit. A light force anywhere on the bumper should close a switch, and when the bumper is released the closed switch or switches must open.

Circuit Assembly. As mentioned earlier, you might want to consider building the Mobile Robot using modular-assembly techniques. If you wish to do so, Digi-Key (701 Brooks Ave. South, Thief River Falls, MN 56701-0677; Tel. 800-344-4539) and other suppliers have numerous connectors that you will find useful. The following assembly instructions will not be specific to the type of connection scheme you use, however.

One connector that you should definitely use is a 14-pin SIP socket to hold the BASIC Stamp module. Make sure the socket you use has 0.1-inch pin spacing, and is rigid, not flexible. The socket should keep the pins of the module from becoming damaged. Insert the module into the socket at this time.

Mount the socketed Stamp module to a piece of perforated board. Using the schematic shown in Fig. 2 as a guide, connect the leads from the servo motors to the circuit. Be careful to connect the correct wires to the correct points. On the Hitec servo specified in the Parts List, the control-signal

LISTING 1

```
'mobile.bas 12 April 1995
'Mike O'Connor


'Simple reactive mobile robot program
'Program reads bumper switches and drives servos.
'Robot travels straight until robot hits an obstacle.
'Robot turns away from the side of bumper switch hit.

'         VARIABLES
symbol status = b2              'state of sensors
symbol rs = b3                  'right servo pulse
symbol ls = b4                  'left servo pulse

'         CONSTANTS
symbol delay = 20           'delay in milliseconds
symbol left = 0             'left servo on pin 0
symbol right = 1            'right servo on pin 1

'         SERVO COMMANDS
'control pulses to servos measured in 10 microsecond
'units
symbol rf = 200             'right forward
symbol rr = 100             'right reverse
symbol rh = 160             'right halt
symbol lf = 100             'left forward
symbol lr = 200             'left reverse
symbol lh = 164             'left halt
'the duration of right halt rh and left halt lh depend on the
'converted servo.  You'll need to determine the correct
'value experimentally.

'                GENERAL
'left servo is on pin 0
'right servo is on pin 1
'left bumper is on pin 7
'right bumper is on pin 6
'
'         STATUS
'condition                  status
'no hit                     0
'right hit                  1
'left hit                   2
'both hit                   3

'make pins 0 and 1 output and all others input
'note pins and dirs are numbered 76543210.
dirs = %00000011
'all pins low
pins = %00000000

main:                   'start of program loop
  status = pins         'read bumper switches
  status = status/64    'divide by 64 to ignore other pins
'determine the appropriate pulses to send to the servos
'based on the status of the bumper switches
  lookup status,(lf,lr,lh,lr),ls
  lookup status,(rf,rh,rr,rr),rs
  pulsout left,ls       'drive left servo
  pulsout right,rs      'drive right servo
  pause delay           'maintain timing of pulses to
'servos
goto main               'return to the start of the loop
```

wire is yellow, the power wire is red, and the ground wire is black. If you're using a servo you're not familiar with, ask someone knowledgeable at a local hobby shop or call the manufacturer.

Attach the leads from the bumper switches to the circuit next. Also, connect the loose wires from the battery pack and power switch. To complete on-board assembly, connect a three-pin header, H1, to the Stamp module and circuit ground. If you're using connectors, be sure to insulate all the soldered joints between wires and connectors with heat-shrink tubing.

Once the connections are all made to the board, mount it to the enclosure using screws and spacers. That completes the assembly of the Mobile Robot, which means it's time to give it some brains. In other words, it's time to program it.

Software. The two programs dealt with below will get your Mobile Robot rolling. Both are in the form of PBASIC that the Stamp can use. If you don't feel like typing them in, and you have a modem, you can download them off the Gernsback BBS (516-293-2283).

Let's start with a simple reflex program that only lets the Robot react to its immediate surroundings. In other words, it provides the Robot with no memory of the past or any knowledge of what it is doing. That program, shown in Listing 1, is a single continuous loop. During each cycle, the Stamp reads the bumper switches and sends out pulses to drive the servos.

The Robot's direction depends on the bumper switches. If neither switch detects a collision, both servos run forward. When a single switch closes, the servo on that side stops while the servo on the opposite side reverses. This causes the Robot to turn away from the obstacle. If both switches are closed, the Robot backs up. The switches are sampled about 40 times a second, so it's rare for both switches to be depressed simultaneously.

A robot running this program will roll across the floor until it hits an obstacle. Then, the Robot will turn away from the obstacle until its path is clear. With this programming, the Robot will tend to follow a wall around a room, and should rarely get stuck in corners.

You might get a real thrill watching your Robot circumnavigate the room for the first time. But after a while, the thrill wears off. That's when you should consider reprogramming the Robot. The next program, see Listing 2, is more complex. Using the program, the Robot examines its past to decide what action it should take. This program improves the Robot's ability to escape from difficult situations.

Programming Tips. It probably won't be too long before the two programs provided for the Mobile Robot will seem a little too limiting. Here are some tips that should make it easier for you to program the Robot on your own.

Keep in mind that this section is not a detailed description of PBASIC. Rather, it simply contains a few programming hints. In order to better understand the syntax of PBASIC, read Parallax's excellent documentation for the Stamp. It is clearly written and filled with helpful examples. A copy of the documentation comes with the BASIC Stamp Programming package.

Programming mobile robots is a trial-and-error process. You'll find that you're writing lots of programs in order

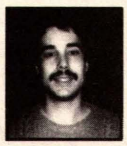
LISTING 2

```
'newmoroa.bas 23 November 1995

'Mike O'Connor


'Program checks bumper switches for hits then drives the
'servos. The program also examines its recent history.  It
'keeps track of the time since its last collision and the last
'bumper switch hit. The robot travels in a straight line until
'it strikes an object. The robot turns away from the side
'that strikes an obsticle. If bumper switch continues to
'detect contact, the robot backs up and turns away from
'the last side to hit an object.

'          VARIABLES
symbol status = b2          'state of sensors
symbol rs = b3              'right servo pulse in 10
'microseconds
symbol ls = b4              'left servo pulse in 10
'microseconds
symbol no_hit = b5          'number of cycles since
'collision
symbol last_hit = b6        'last bumper switch hit
symbol count = b7           'counter for backup cycle
symbol turn_count = b8      'number of cycles of turning

'          CONSTANTS
symbol delay = 20           'pause in milliseconds to time
'pulses
symbol left_servo = 0       'left servo on pin 0
symbol right_servo = 1      'right servo on pin 1
symbol left_hit = 0         'flag for last bumper hit
symbol right_hit = 1        'flag for last bumper hit

'          SERVO COMMANDS
'pulse duration is in 10's of micro seconds
symbol rf = 200             'right forward
symbol rr = 100             'right reverse
symbol rh = 160             'right halt
symbol lf = 100             'left forward
symbol lr = 200             'left reverse
symbol lh = 164             'left halt

'          GENERAL
'looking at vehicle from the top with front pointing away
'left servo is on pin 0
'right servo is on pin 1
'left bumper is on pin 7
'right bumper is on pin 6

'          STATUS
'condition                  status
'no hit                     0
'right hit                  1
'left hit                   2
'both hit                   3

'          PROGRAM
'initialize i/o pins
'make pins 0 and 1 output and all others input
dirs = %00000011
'all pins low
pins = %00000000

read_bumpers:
 status = pins
 status = status/64        'ignore everything except pins 6
'and 7
 branch status,(straight,left,right,backup)
straight:
 turn_count = 0
 ls = lf
 rs = rf
 if no_hit > 250 then skip  'avoid over running the variable
  no_hit = no_hit + 1
 skip:
  gosub drive_servos
goto read_bumpers

left:
 turn_count = turn_count + 1
 last_hit = right_hit
 if turn_count > 20 then backup
 if no_hit > 5 and no_hit < 10 then backup
 no_hit = 0
 ls = lr
 rs = rh
 gosub drive_servos
goto read_bumpers

right:
 turn_count = turn_count + 1
 last_hit = left_hit
 if turn_count > 20 then backup
 if no_hit > 5 and no_hit < 10 then backup
 no_hit = 0
 ls = lh
 rs = rr
 gosub drive_servos
goto read_bumpers

backup:
 no_hit = 0
 for count = 0 to 20
  ls = lr
  rs = rr
  gosub drive_servos
 next
 if last_hit = left_hit then skip_to_right
  ls = lr
  rs = rh
  goto do_servos
 skip_to_right:
  ls = lh
  rs = rr
 do_servos:
 for count = 0 to 20
  gosub drive_servos
 next
goto read_bumpers

drive_servos:
 pulsout left_servo,ls
 pulsout right_servo,rs
 pause delay
return
```

to create a few good ones. It's important to keep track of your work. Start organized and stay organized. Consider creating a subdirectory for your programs to keep them separate from other ones.

The Stamp's editor can save programs to and load programs from the disk but it can't show you a list of your

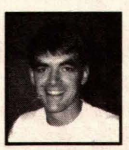
Just like these Fully Trained Electronics Professionals



"Thanks to CIE I have tripled my previous salary, and I am now in a challenging and rewarding new field where only the sky is the limit."
Daniel Wade Reynolds
Industrial Electrician
Ore-Ida Foods

"CIE was recommended to me by my boss. It was appealing since I could study at my own pace at home and during business travel."
Dan Parks
Marketing Manager/Consumer Products
Analog Devices, Inc.

"I loved the flexibility CIE offered. It was the only way I could continue both school and my demanding job."
Britt A. Hanks
Director of Engineering
Petroleum Helicopters, Inc.



"I liked the way the school was set up with laboratory assignments to enforce conceptual learning. The thing which impressed me the most about CIE's curriculum is the way they show application for all the theory that is presented."
Daniel N. Parkman
Missile Electro-Mechanical Technician
U.S. Air Force

"Completing the course gave me the ability to efficiently troubleshoot modern microprocessor based audio and video systems and enjoy a sense of job security."
Tony Reynolds
Service Manager/Technician
Threshold Audio & Video

Graduate with an Associate Degree from CIE!

CIE is the best educational value you can receive if you want to learn about electronics, and earn a good income with that knowledge. CIE's reputation as the world leader in home study electronics is based solely on the success of our graduates. And we've earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

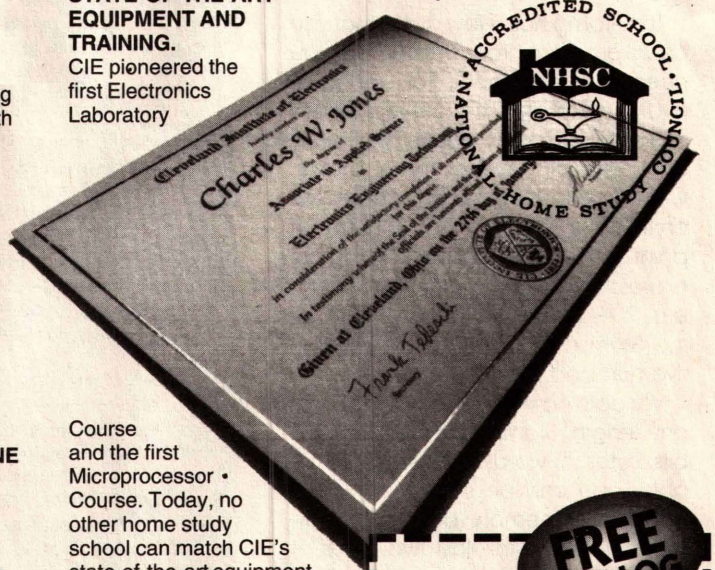
Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world. They'll tell you success didn't come easy...but it did come...thanks to their CIE training. And today, a career in electronics offers more rewards than ever before.

CIE'S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.
CIE isn't another be-everything-to-everyone school. CIE teaches only one subject and we believe we're the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we're the largest home study school specializing exclusively in electronics. CIE has been training career-minded students for nearly sixty years and we're the best at our subject...
ELECTRONICS...
IT'S THE ONLY SUBJECT WE TEACH!

CIE PROVIDES A LEARNING METHOD SO GOOD IT'S PATENTED.
CIE's AUTO-PROGRAMMED® lessons are a proven learning method for building valuable electronics career skills. Each lesson is designed to take you step-by-step and principle-by-principle. And while all of CIE's lessons are designed for independent study, CIE's instructors are personally available to assist you with just a toll free call. The result is practical training... the kind of experience you can put to work in today's marketplace.

LEARN BY DOING...WITH STATE-OF-THE-ART EQUIPMENT AND TRAINING.
CIE pioneered the first Electronics Laboratory Course and the first Microprocessor • Course. Today, no other home study school can match CIE's state-of-the-art equipment and training. And all your laboratory equipment, books and lessons are included in your tuition. It's all yours to use while you study and for on-the-job after you graduate.

PERSONALIZED TRAINING....TO MATCH YOUR BACKGROUND.
While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.


Cleveland Institute of Electronics
Charles W. Jones
Electronics Engineering Technology
Given at Cleveland, Ohio on the 27th
ACCREDITED SCHOOL • NATIONAL HOME STUDY COUNCIL •
NHSC

Send for CIE's FREE Course Catalog and See How We Can Help Your Career Too!

FREE CATALOG

YES! I want to get started. Send me my CIE course catalog including details about the Associate Degree Program. (For your convenience, CIE will have a representative contact you - there is no obligation.)

Please Print Clearly

Name _____

Address _____

City _____

State ____ Zip _____ Age ____

Phone No. _____

Check box for G.I. Bill Benefits.
☐ Veteran
☐ Active Duty

AH81

Cleveland Institute of Electronics, Inc.
1776 East 17th Street
Cleveland, OH 44114

A School of Thousands.
A Class of One. Since 1934.

CIRCLE 16 ON FREE INFORMATION CARD

programs. For that reason you might want to use the editor to create a file that keeps track of all your BASIC Stamp programs. Use the .BAS extension for the file so that the editor can read and write to it. Then, whenever you write a new program, update your program list. Be sure to include a brief description of each program and helpful comments about its operation; that way you'll know which ones to use and what to use each of them for.

There's another important reason to keep a current program list. When you save a program, the editor does not check to see if a program with that name already exists. If you're not careful, you could overwrite good programs.

The Stamp has a few quirks that you could program around, but which you need to know about. For starters, it evaluates mathematical equations differently than you would. The Stamp only performs integer math; that is, when it performs division, it ignores everything to the right of the decimal point. Also, mathematical and logical expressions are evaluated left to right; *e.g.*, 7 + (2 × 5) = 45, not 17. Finally, the Stamp cannot recognize negative numbers.

Variable names in PBASIC can be of any length. Stamp variables can be bits, bytes, or words. However, bit variables can only be stored in the first two bytes of memory (b0 and b1). Variables stored in the last two bytes of memory (b12 and b13) might interfere with GOSUB instructions. Before you use a variable, it needs to be defined by the SYMBOL instruction.

A great feature of the Stamp's instructions is that many of them match the needs of the robotics hobby. The PULSIN and PULSOUT instructions can receive or emit a pulse accurate to ten microseconds. PULSOUT is perfect for driving servos. The PAUSE instruction creates a delay that's used to control the refresh frequency of the servos. Variations in the refresh rate, caused by changing pulse lengths or the different execution times of various instructions, usually don't cause any problems. Just remember that the PULSE and PAUSE instructions use different units of time. PULSIN and PULSOUT use ten-microsecond units while PAUSE measures time in thousandths of a second.

SUGGESTED READING

Books

The *BASIC Stamp Manual 1.2*, published in 1995 by Parallax Inc. (3805 Atherton Road, #102, Rocklin, CA 95765), is the documentation that comes with the BASIC Stamp. It contains clear, detailed descriptions of the Stamp and all PBASIC instructions. Twenty example applications with complete program listings and schematics are also found in this 172-page book.

H.R. Everett's *Sensors for Mobile Robots: Theory and Application*, published in 1995 by A K Peters (289 Linden Street, Wellesley, MA 02181), explains the theory behind a wide variety of sensors. The book describes a number of experimental and commercial sensors, though most of the systems covered are a bit expensive for hobbyists.

Mobile Robots: From Inspiration to Implementation by Joseph L. Jones and Anita M. Flynn is another excellent A K Peters book. The breakthrough text guides the reader through sensors, motors, and software. You'll also find the list of part suppliers helpful. A K Peters sells kits of the Rug Warrior robot featured in the book.

Fred Martin, Pankaj Oberoi, and Randy Sargent have written the *The 6.270 Robot Builder's Guide*. This collection of class notes from the MIT Lego Robot Design Competition is now in its second edition, published by The Epistemology and Learning Group (Massachusetts Institute of Technology, 20 Ames Street, Room E15-309, Cambridge, MA 02139). The chapter on sensors is particularly useful.

Gordon McComb's *The Robot Builder's Bonanza: 99 Inexpensive Robotics Projects* is a good introduction to most of the topics hobbyists building robots need to know about. The book was published by Tab Books (Blue Ridge Summit, PA 17924-0850) back in 1987, so some parts are outdated.

Robotics Age: In the Beginning is a compilation of articles from *Robotics Age* magazine that was compiled by Carl Helmers. Published by Hayden (Rochelle Park, NJ) in 1983, the book's been out of print for over a decade. However, it contains a number of articles that are still useful; the piece on stepper motors is excellent.

Periodicals

The Robotics Practitioner, published by Footfalls, Ltd. (483 S. Kirkwood Road, Suite 130, Kirkwood, MO 63122), is a new quarterly magazine. If you build robots, or even if you're merely interested in robotics, you should consider subscribing.

The monthly newsletter *Robots!*, published by the Robotics Society of America (P.O. Box 1205, Danville CA 94526-8205), contains meeting summaries, book reviews, feature articles, and contest announcements.

The Stamp's BUTTON instruction reads and debounces a switch, then performs a GOTO when conditions are met. BUTTON is great for user-operated interfaces, but for reading bumper switches it is better to read the pins directly. Switches S2 and S3 are connected to the highest-numbered pins in the Robot (P6 and P7). Program the Stamp to read their values with the PINS instruction. Once the Stamp knows the status of a robot's bumper switches, the program running should contain IF...THEN or BRANCH instructions to send the execution of the program to the appropriate address.

The PINS instruction doesn't debounce the switches. However, because the Stamp reads the switches and drives the servos about 40 times a second, that isn't much of a problem. A small, slow robot like this one isn't going to get into much trouble in a fortieth of a second.

The Stamp accepts other forms of input as well. The POT instruction allows the Stamp to read a variable resistance by measuring the amount of time needed for a capacitor to discharge through the unknown resistance. That allows a mobile robot with CdS photoresistors to track a light source. Unfortunately, the POT instruction executes slowly because it must wait for a capacitor to charge and discharge. The time needed to execute POT will slow the refresh rate of the servos. Using the POT command while a robot is moving will slow that robot to a jerky crawl.

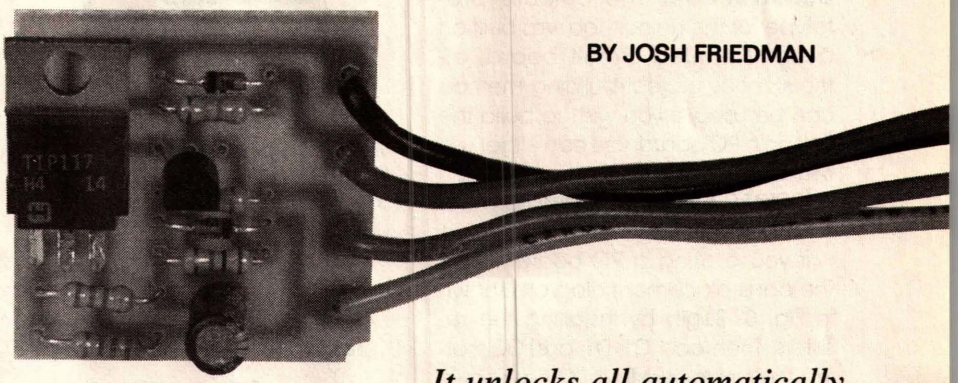
There are other ways to interface analog devices. For sensors that produce varying voltages, you can use analog-to-digitial (A/D) or voltage-to-frequency converters. The BASIC Stamp Manual explains how to interface the National Semiconductor ADC0831 A/D converter using three of the Stamp's pins. A voltage-to-frequency converter only requires a single pin and the PULSIN instruction.

As you can tell, the Robot is not limited to the bumper-switch sensors. Because the Robot only uses four of the Stamp's eight I/O lines, new sensors can be added to the unused lines. Additional bumper switches could provide 360-degree contact detection. Also, sonar or IR proximity detectors could enable the Robot to avoid obstructions instead of running into them.

Keep the Mobile Robot's versatility in mind. Using the Robot as a base for future experiments could be a lot of fun. ■

BUILD THE UNLOCK-TOO

BY JOSH FRIEDMAN



It unlocks all automatically locking vehicle doors when you turn off the ignition.

Certain new vehicles are equipped with power door locks that automatically lock when the transmission is shifted into gear. Unfortunately, you have to manually unlock the doors before exiting, which some might find inconvenient. If you have a vehicle with that feature, and would like to correct what many consider to be a design flaw, consider building the *Unlock-Too* described in this article. It automatically unlocks all vehicle doors when the ignition switch is turned off.

Unlock-Too will work on any self-locking, power door-lock system that uses a positive-voltage pulse-controlled relay. Several General Motors products built between 1992 and 1994 used such a system. Those included the Chevrolet Cavalier and Lumina, Pontiac Grand-Am and Grand-Prix, Oldsmobile Achieva, Cutlass Supreme and Ciera, and Buick Skylark and Century models.

Automatic-Lock Basics. Inside each door of a vehicle with power locks is an actuator whose main component is a reversible motor. When a door-lock switch is pressed, to either the lock or unlock position, battery power is applied to a corresponding relay (there's one for each position, although in many vehicles both the lock and unlock relays are in the same enclosure). The relay then applies the correct polarity voltage to the actuators, which perform the desired lock or unlock function.

In a car with automatic locks, turning on the ignition has the effect of activating the lock relay and actuators. The Unlock-Too does the opposite when installed in parallel to a vehicle's unlock relay. When the ignition switch of a vehicle equipped with the Unlock-Too is turned off, the unit closes the vehicle unlock-relay contacts for about half a second. That, of course, results in the doors becoming unlocked.

Circuit Description. The schematic for the Unlock-Too is shown in Fig. 1. For the following discussion, assume the circuit is installed in a vehicle.

When the ignition switch is on, the "+12V" and "IGN" lines connected to the circuit are within half a volt or so of each other. Resistor R3 reverse biases Darlington Q2 and keeps it cut off. Transistor Q1 is in parallel with Q2's emitter and collector; Q1 is "on" due to the large voltage drop across Q2's emitter and collector, but that has no effect on the circuit at this time.

When the ignition switch is turned off, voltage is removed from the "IGN" line, effectively placing R5 at ground level. That change occurs because the vehicle components also connected to the ignition power source act like a very low-value resistor in series with R5 to ground. Capacitor C1 provides a path for current to flow through R3–R5 and the vehicle components to ground. That flow will forward bias Q2, driving it into saturation and lowering its emitter/collector voltage to less than 0.5 volt. As a result, almost full battery voltage is applied to the vehicle unlock relay; transistor Q1 is cut off at the same time. The voltage divider of R3 and R4 prevents false triggering during voltage sags on the "IGN" line.

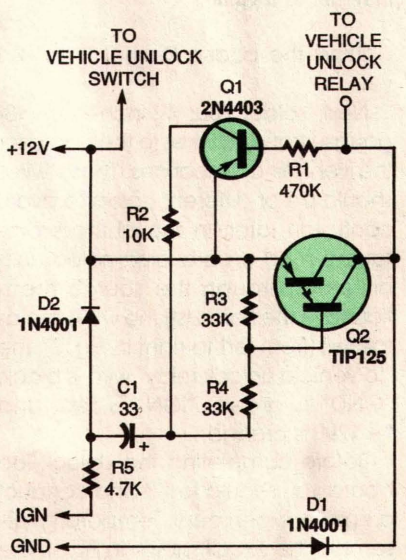


Fig. 1. When the Unlock-Too is connected to a vehicle, shutting the ignition switch off results in a forward biasing of Q2, which applies almost full car-battery voltage to the door unlock relay.

As current flows through C1 the capacitor begins to charge through R3–R5. Over time, less current will be available to forward bias Q2 and maintain saturation. When Q2's emitter/collector voltage drop reaches about 0.6 volts, Q1 will begin to conduct, forming a feedback loop with R1 and R2 that adds extra charge current to C1. That has an avalanche effect. The faster C1 charges, the faster Q2's emitter/collector voltage-drop increases. Then, the more current that Q1 conducts, the faster C1 charges and the faster Q2 is turned off.

As connected in the circuit, Q2 has a fast turn-off time. That turn-off action quickly opens the vehicle unlock-relay contacts and prevents them from chattering. After Unlock-Too turns off, a slight current flows through Q1, R1, and the vehicle unlock-relay coil to ground. Because the current is less

than 30 microamperes, there is no danger of discharging the vehicle's battery over time. Diode D1 suppresses voltage spikes when the unlock relay is turned off.

Construction. The author's prototype for the Unlock-Too was built on a small printed-circuit board, although any project-building method can be used. If you wish to build the unit on a PC board, you can either use the foil pattern shown in Fig. 2 to etch your own, or buy a board from the source mentioned in the Parts List.

If you're using a PC board, follow the parts-placement diagram shown in Fig. 3. Begin by installing the resistors. Then add C1, D1, and D2, noting their polarity. Mount Q2 as shown in Fig. 3 (the tab is to the left). If you wish, gently bend the leads with needlenose pliers so that Q2 lies flat against the board. Do not install Q1 yet.

PARTS LIST FOR THE UNLOCK-TOO

SEMICONDUCTORS

Q1—2N4403 PNP transistor
Q2—TIP125 or TIP117 PNP power Darlington transistor
D1, D2—1N4001 silicon rectifier diode

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1—470,000-ohm
R2—10,000-ohm
R3, R4—33,000-ohm
R5—4700-ohm

ADDITIONAL PARTS AND MATERIALS

C1—33-μF, 25-WVDC, electrolytic
Printed-circuit materials, project enclosure or Plastidip, 3M Blue Scotch Lock connector splices (optional), 18-gauge wire, solder, hardware, etc.

Note: The following are available from Josh Friedman (2665 Balfour Street, Eugene, Oregon, 97408): etched and drilled PC board—$6.00; assembled Unlock-Too unit, sealed, with four 12-inch colored wires soldered in place—$16.00. Shipping and handling for the continental U.S. is included in all prices (write for international shipping information). Checks and money orders accepted (drawn on U.S. banks only). Shipping will be delayed until personal checks clear. Oregon residents please add appropriate sales tax.

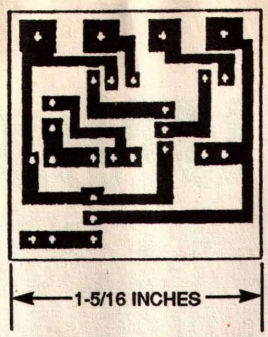


Fig. 2. If you'd like to etch your own PC board for the Unlock-Too, use this full-size template.

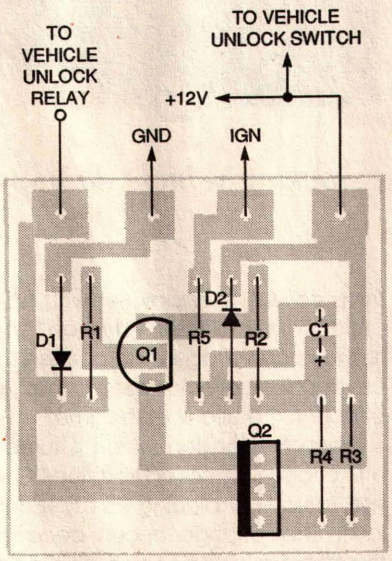


Fig. 3. When building the Unlock-Too on a PC board, use this parts-placement diagram as a guide.

Next, solder four 12-inch-long, 18-gauge stranded wires to the board for the vehicle connections. Those wires should be of different colors to avoid confusion later. In the author's prototype (and on any assembled units ordered through the source mentioned in the Parts List) the wires are as follows (from left to right in Fig. 3): the "to vehicle unlock relay" wire is black, "GND" is green, "IGN" is red, and "+12V" is orange.

Before completing the Unlock-Too board you should test it and conduct a simple experiment. Temporarily assemble the circuit shown in Fig. 4. The open-circle connections for "+12V" and "IGN" and the arrow connection for the "vehicle unlock relay" correspond to the matching leads on the PC board. Tack solder the components shown in Fig. 4 to the ends of the leads. The "GND" wire will not be used at this time.

Connect the test circuit to a 12-volt DC source and touch JU1 to the leads, as shown, for about 5 seconds. That simulates turning on the ignition. Then, remove JU1, simulating that the ignition is turned off. As mentioned earlier, Q1's feedback gives Q2 a fast turn-off time; without it, the LED should quickly come on but gradually turn off. If that had been a relay, its contacts would chatter when they tried to open, which would eventually damage the contacts and possibly the connected load.

Remove power from the circuit and install Q1, observing the orientation in Fig. 3. Then, perform the test again. This time, when JU1 is connected and removed, LED1 will turn on and after a half-second delay turn abruptly off. If any time during this test the Unlock-Too does not operate as mentioned, double-check the solder connections and wiring.

You can put the circuit board in any small, suitable enclosure. The author sealed the finished prototype board in Plastidip. That sealer is usually used to coat handles of small hand tools and is readily available in most hardware stores as a dip or spray. If you would like to do the same, trim the component leads as close as possible before applying the sealer to the finished circuit board. (Note that having different-color wires is mandatory if you plan on sealing the board.)

Installation. Before you begin installing the Unlock-Too, roll down a window to prevent locking yourself out of your vehicle. Also, keep in mind that all vehicles are different and we can't include make- and model-specific installation details. However, a generic connection diagram is shown in Fig. 5. If you don't feel comfortable with your vehicle's electrical system, you might want to ask an automotive technician for help.

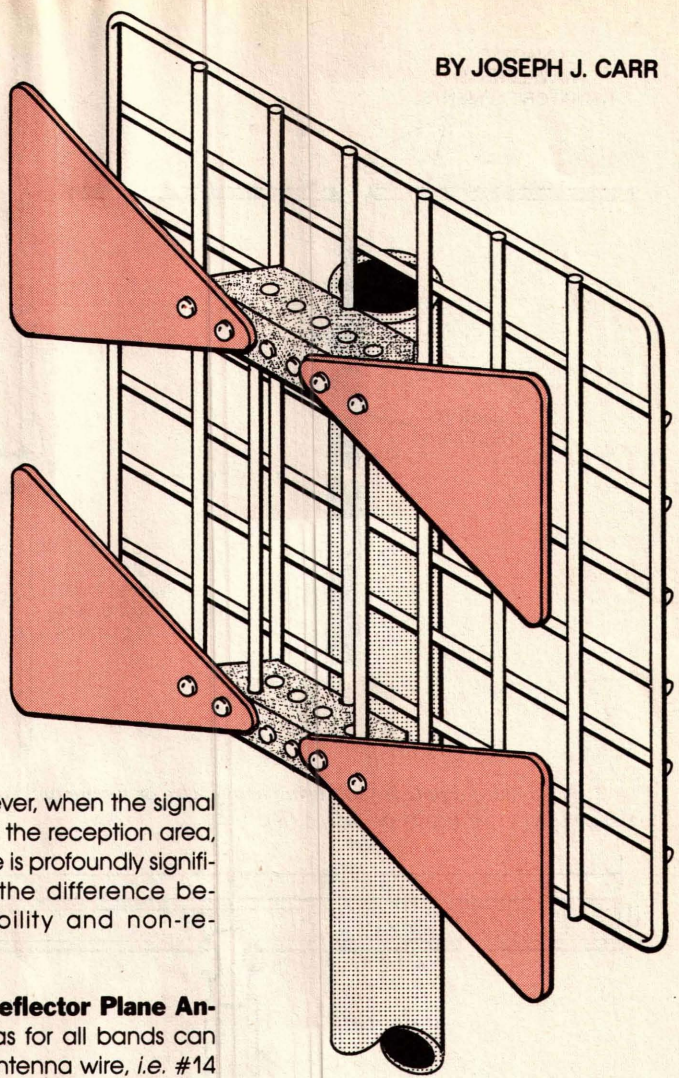
Here's some useful information for those who drive the GM models listed earlier: They use a single relay package for lock and unlock functions. The relay can be identified by an in-line six-wire connector. Those six wires are arranged as follows: black (to the unlock switch), tan (to the actuators), black (ground), orange/black (+12

(Continued on page 56)

All About Reflector Antennas

BY JOSEPH J. CARR

Try these low-cost, easy-to-build antenna designs and get better performance from your VHF/UHF radio gear.



At one time, enthusiasts who monitored the VHF/UHF bands faced a dearth of good equipment. What was available a couple of decades ago was either single channel (or a few crystal-controlled channels), unstable, insensitive, or all three. Today, there is a huge number of VHF/UHF scanner receivers on the market, and the number of scanner-monitoring enthusiasts grows every year.

The growing number of scanner enthusiasts have many things in common with their brethren who work the lower frequencies; one of them is the need for a good antenna to get the most out of their gear. In this article, we will take a look at reflector antennas for use in VHF/UHF receiving applications.

What Are Reflector Plane Antennas? Reflector antennas are dipoles, or multiple dipoles, backed by a reflector plane located a quarter wavelength behind the dipoles (see Fig. 1). That arrangement converts a bidirectional dipole antenna into a unidirectional antenna. Because of the change in reflectivity, the gain of the reflector plane antenna is 3 dB higher than the dipole alone.

So what does 3 dB mean? In terms of power, the reflector antenna delivers twice as much received signal power to the antenna terminals of the receiver than the dipole. If the receiver has an S-meter, a 3-dB increase would represent about a half of an S-unit. In practical terms, when signals are strong, a 3-dB increase, while perceptible, won't make that much of a difference. However, when the signal is at the fringe of the reception area, the 3-dB increase is profoundly significant; it means the difference between receivability and non-receivability.

Materials for Reflector Plane Antennas. Antennas for all bands can be made with antenna wire, *i.e.* #14 stranded, copper-clad steel wire. But at VHF/UHF, several other options present themselves. The reason is that the wavelengths are much shorter, and most antennas are either quarter-, half-, or one-wavelength long. At 100 MHz (in the middle of the FM broadcast band), a half wavelength is 59 inches; at 400 MHz, it is 14.75 inches; and at 650 MHz, it is 9 inches.

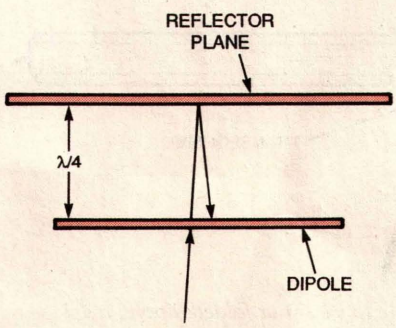


Fig. 1. The concept of a reflector antenna is quite simple—a dipole backed by a reflector plane spaced a quarter-wavelength away.

One option is the use of 300- or 450-ohm twin-lead transmission line in a folded dipole or another configuration. Another option is to make antenna elements out of #10, #12, or #14 solid wire, such as the wire used to carry electrical current in your house (make sure it's copper, not aluminum, or else it won't solder).

Brass and copper tubing is easily available at hardware and hobby stores. Copper-plumbing tubing comes in ¼-inch, ⅜-inch, ½-inch, ¾-inch, and 1-inch sizes. Hard drawn pipes are available in straight lengths of 4, 6, 8, and 12 feet (I'm told that 16-foot lengths are also available, but the lengths listed were actually found in a do-it-yourself hardware store when I surveyed it for this article). Soft drawn copper is more flexible, and comes in coils. The same diameters are available in coiled copper, but it's best to limit the use to the smaller sizes.

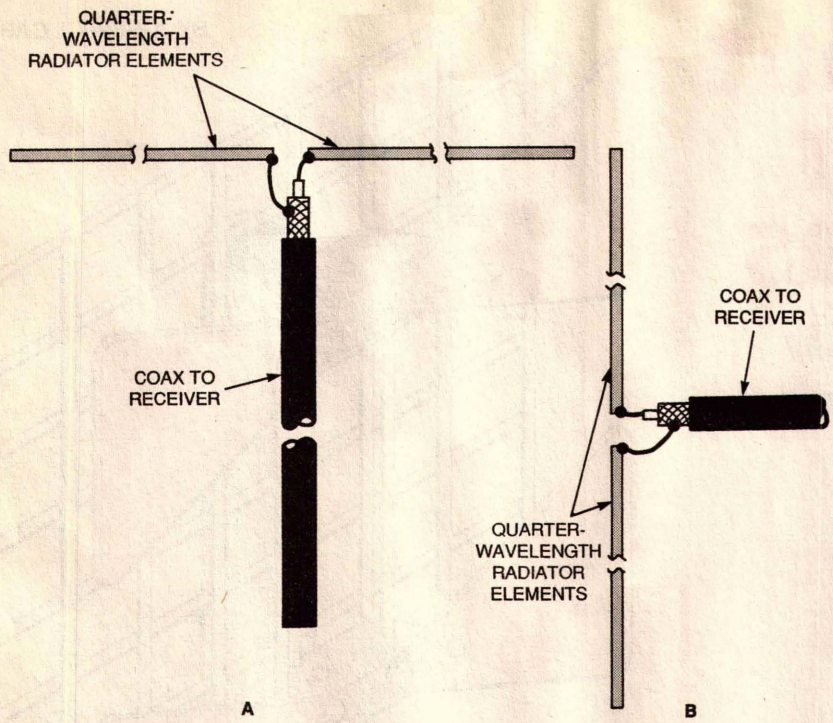


Fig. 2. A standard dipole is built using heavy wire or tubing and could be horizontally polarized (A) or vertically polarized (B).

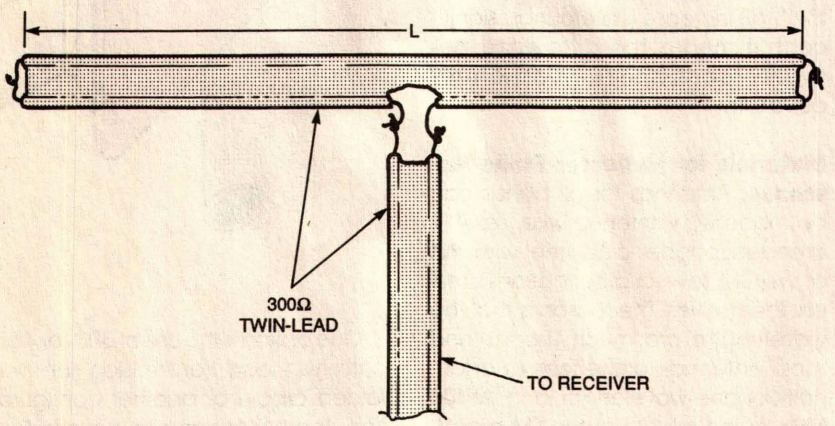


Fig. 3. TV-type 300-ohm twin-lead is ideal for making a folded dipole. Be sure to short the conductors together at both ends as shown.

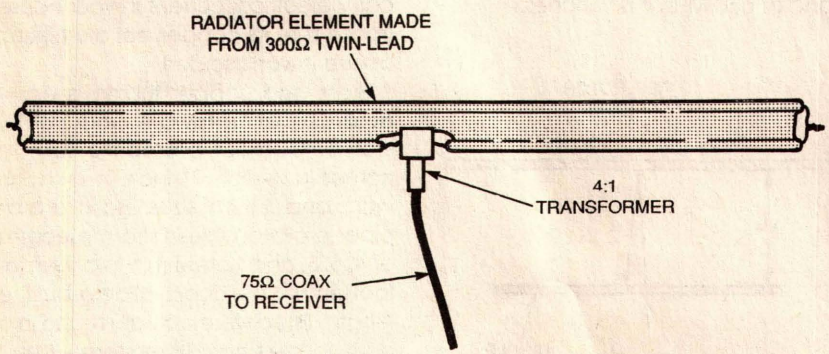


Fig. 4. If you want to use 75-ohm coaxial cable to feed your folded dipole, a 4:1 BALUN transformer should be used at the feedpoint.

Hobby shops are a good source of brass tubing and rods. They come in diameters from about 3/32 to 3/4 inch, and in lengths of 12, 18, and 24 inches. Again, there might be other lengths and diameters available, but on the morning I surveyed two local hobby/model shops, these were the sizes in stock.

It's possible to use copper foil and copper plate for either certain types of radiator element, or for the reflector screen. I've used roofing copper, but that's not optimal. The reason is that it's heavy gauge, so it must be worked with sheet-metal shears (and even then it's a pain). It's also terribly expensive stuff. One thing that drives the cost up is that roofing copper is not easily obtained in do-it-yourself hardware stores, but rather has to be obtained from commercial metal distributors. The one I dealt with had a $50 minimum order, so I bought a roll of 7-inch-wide, 1-pound/square-foot roofing copper (and because I don't use a lot at one time, that roll has lasted a long, long, time!).

Lighter gauge copper foil is available from hobby shops. I've seen 32-, 36- and 40-gauge copper foil. The latter is easily worked with dull scissors, but one has to be careful lest it crinkle. I found both sheets and rolls of all three gauges at arts and crafts shops. The largest supply was found at a specialty hobby shop that deals with dollhouse builders (who use it for copper roofs).

Radiator Elements: The Dipole. The actual antenna element, the radiator, in these designs is the dipole (of which, several varieties are used). The dipole is a half-wavelength radiator element that is fed in the center with 75-ohm coaxial cable. The antenna in Fig. 2A is for horizontally polarized signals, while the one in Fig. 2B is for vertically polarized signals. It is more important to get the polarity correct when working with VHF/UHF signals than it is for HF shortwave. The reason is that long-distance ionospheric propagation of HF signals makes the polarity of the received signal a jumbled random mess. But at VHF/UHF frequencies, it's likely to be the same at the receiver as it was at the transmitter.

At VHF/UHF frequencies, the dipole radiator element can be made of #12 or #10 solid wire, or copper/brass tubing of 1/4-inch to 1/2-inch size (I found in building a couple of these antennas that the 3/8-inch tubing

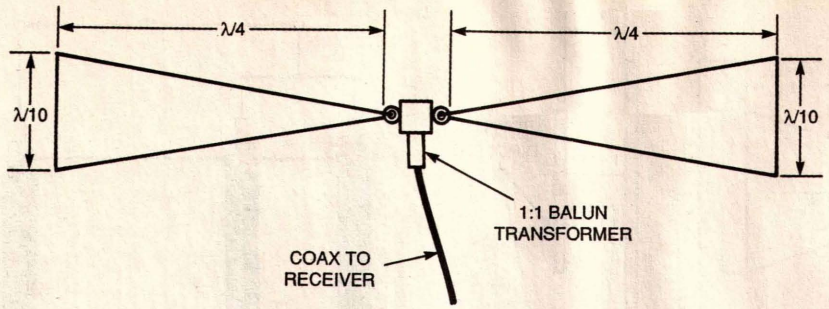


Fig. 5. The "Fan" dipole (also known as the "Bow Tie" dipole) is a variation of the folded-dipole theme.

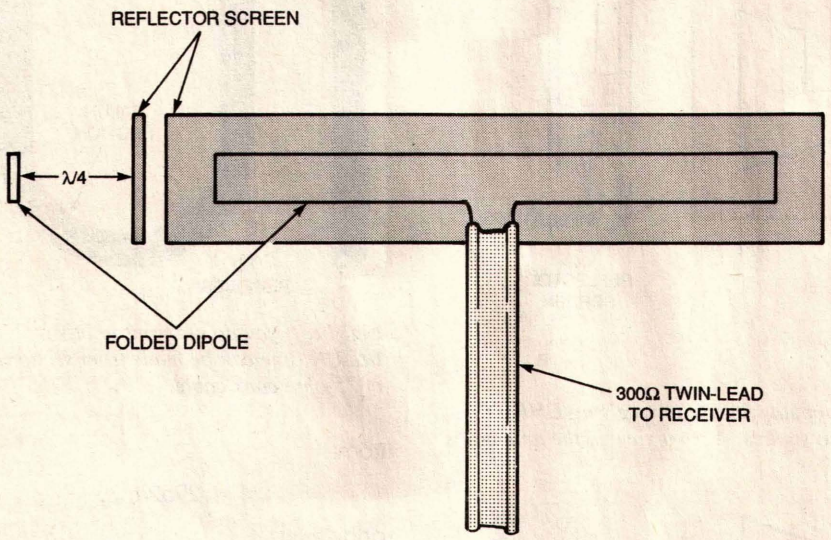


Fig. 6. The folded dipole reflector antenna consists of a folded dipole placed a quarter wavelength in front of a reflector plane; the plane should be flat, and about 15- to 20-percent larger that the dipole's length.

seemed to be the best compromise).

The overall length of the dipole is given by the following equation, and each element is one-half this length:

$$L = 5904/f_{MHz}$$

Where L is the length of the radiator element in inches, and f_{MHz} is the frequency in megahertz. Work that equation on a calculator, and you will discover where I got the lengths used in the examples given earlier in this article.

In Fig. 3, we see a folded dipole. That antenna is made from 300-ohm twin-lead transmission line. The length is as calculated from the previous equation. The ends of the two conductors of the twin-lead are scrapped clean of insulation (remove about 0.75 inches from each conductor). The two conductors (at both ends) are then twisted together and soldered. One of the conductors is split at the exact center. The insulation is stripped off for about 0.5 inch, and the wire cut. The two ends become the point at which the 300-ohm transmission line to the receiver is connected.

In some cases, you might wish to use a 4:1 BALUN transformer (see Fig. 4) at the center feed point in order to allow 75-ohm coaxial cable to be used between the antenna and receiver (instead of the 300-ohm twin-lead).

A variation on the theme is the fan dipole in Fig. 5. The elements of the fan dipole are made of two conductors that are spread apart enough to be about one-tenth wavelength (λ/10) at the ends. The bandwidth of the fan dipole is a bit greater than regular dipoles, even though it is a little harder to build. Like other dipoles, the elements are each a quarter wavelength (λ/4), for an overall length of a half wavelength (λ/2). The fan dipole can be fed directly with 75-ohm coaxial cable, or through a 1:1 BALUN transformer if one is available for the frequency that you select.

Folded Dipole Reflector Antenna. The folded dipole in Fig. 6 is mounted a quarter wavelength in front of a reflector plane. The reflector plane can be made of copper foil glued to a wooden or foam-core poster-board backing (Fig. 7A). Alternatively, it can be fashioned as a grid of #10 or #12 solid wire, or the brass rods mentioned above (Fig. 7B). If the grid method is used, solder the wires or rods together at the points where they cross each other. Be careful not to distort this assembly; it is important to keep the plane of the reflector flat. The size of the reflector is about 15% to 20%

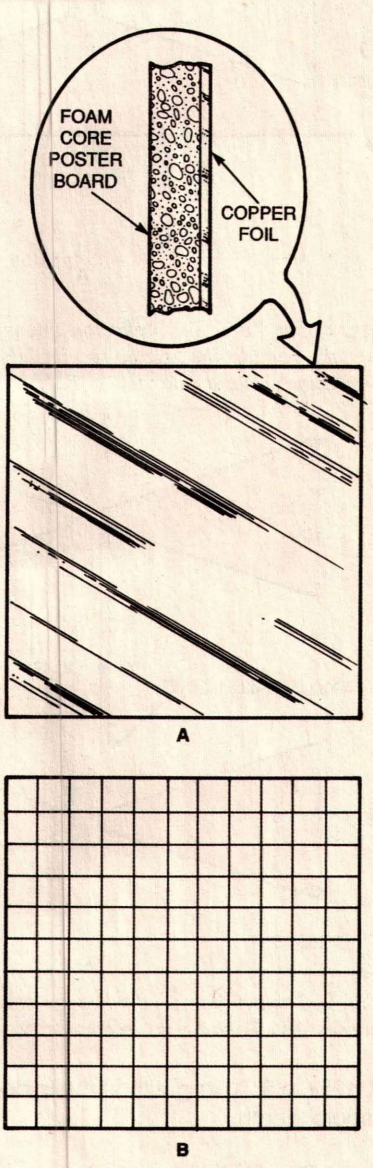


Fig. 7. The reflector plane can be made from a variety of materials. For example, copper foil over a wood, plastic, or foam-core poster board (A) or a wire grid made of #12 solid wires, or metal rods (B).

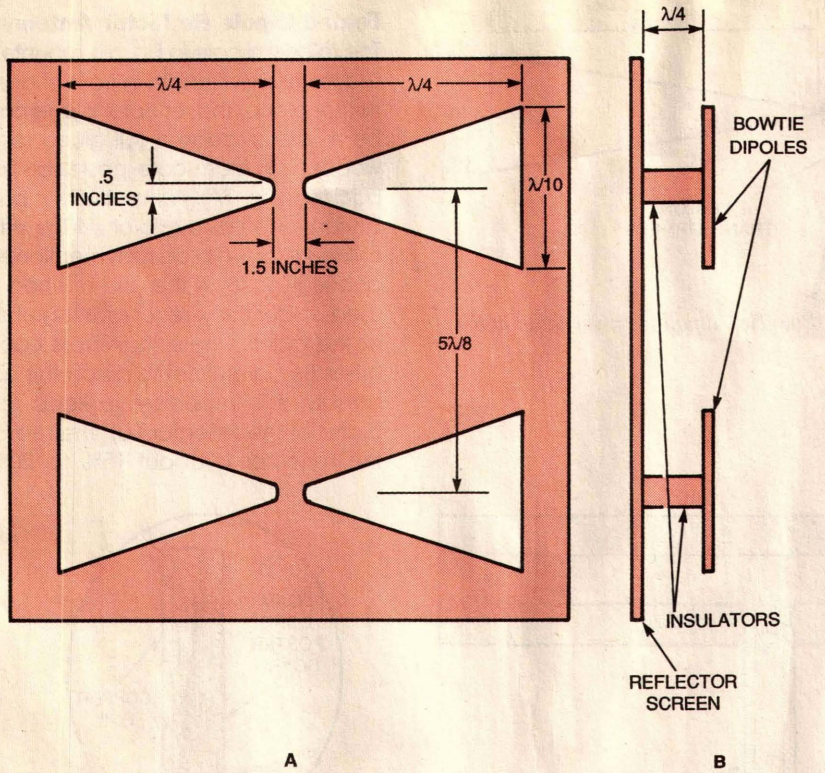


Fig. 8. The "Bow-Tie" reflector antenna, so popular for use in receiving UHF TV signals, can also be used to receive UHF radio signals. A front view of the antenna is shown in A, and a side view in B.

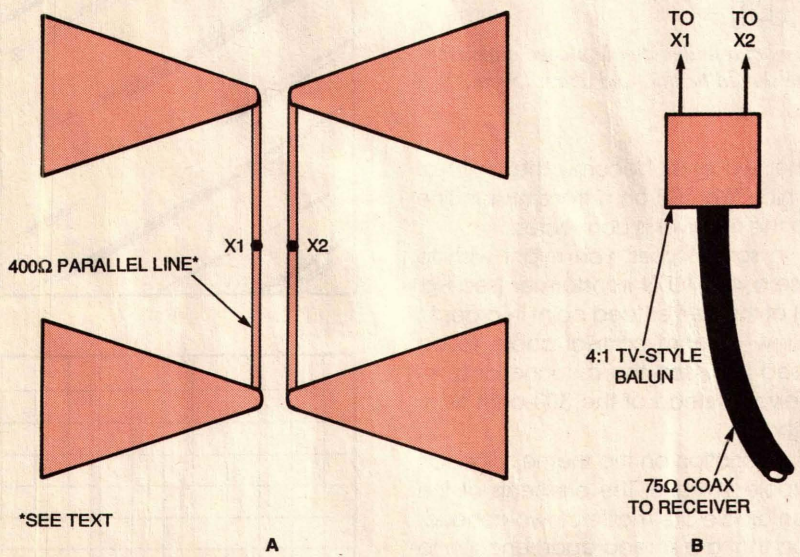


Fig. 9. The two bow-tie dipoles are connected together by a 400-ohm transmission-line harness (A). To use coax to connect to your rig, again use a 4:1 BALUN transformer.

(0.125λ to 0.2λ) larger than the folded dipole length.

Bow-Tie Reflector Antenna. A bow-tie reflector antenna is seen in Fig. 8A (frontal view) and Fig. 8B (side view); it is capable of about 6 dB gain. That type of antenna is very popular as a UHF TV antenna, and can be pressed into service for those scanner frequencies that lie close to the UHF-TV band as well. The dipole elements are made of sheet metal (preferably copper or brass). Each element is triangle shaped, fanning from ⅛-inch at the feedpoint to 1/10 wavelength at the ends, and is a quarter wavelength long. These lengths are calculated

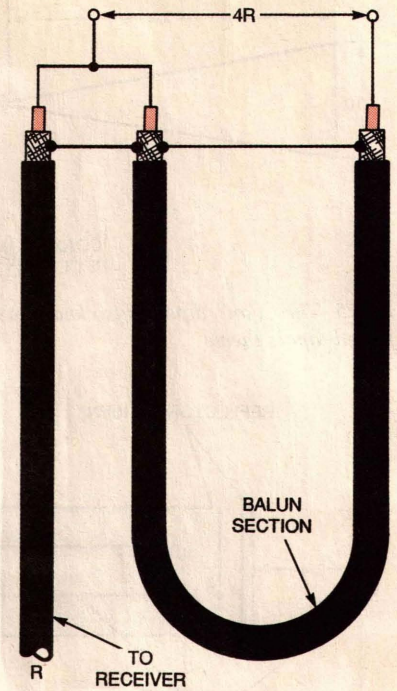


Fig. 10. If you do not want to buy a BALUN, one can be made from sections of 75-ohm coax cable.

from:

$$\lambda/4 = 2952/f_{MHz}$$

and,

$$\lambda/10 = 1180/f_{MHz}$$

The dipole elements are spaced 1.5- to 4-inches apart, to form a complete half-wavelength dipole. The dipoles themselves are mounted in the same plane, but 5/8-wavelength (5λ/8) apart. That distance is calculated from:

$$5\lambda/8 = 7380/f_{MHz}$$

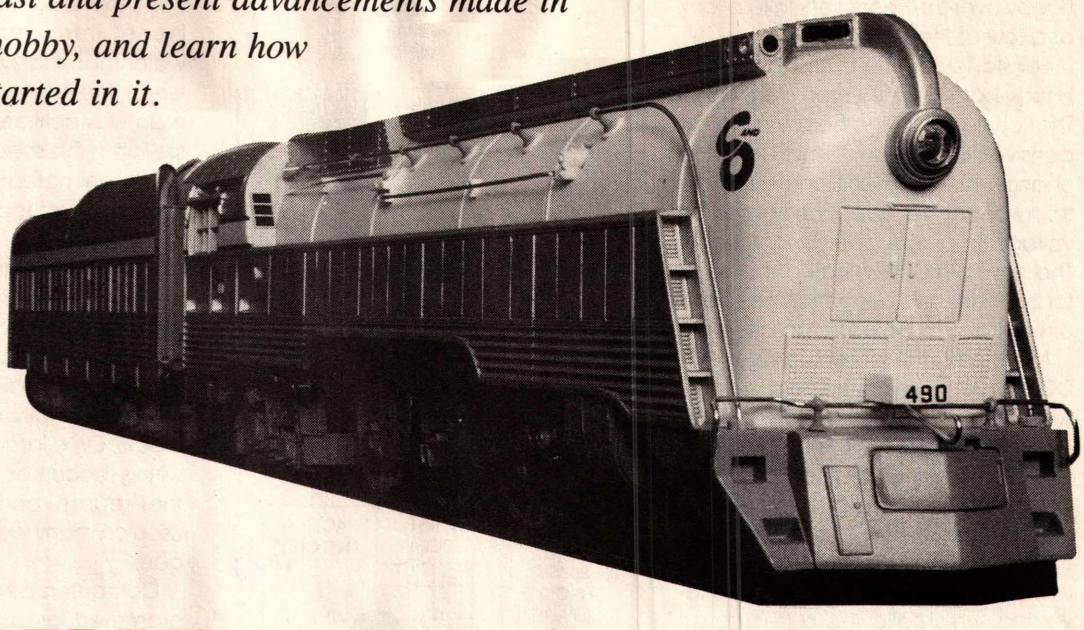
The reflector screen should be about 20% longer than the dipole elements, and can be made exactly as above for the reflector folded dipole antenna.

The two dipoles are connected together by a transmission-line harness (Fig. 9A), which is a 400-ohm transmission line fashioned from either #12 solid copper wires (or the equivalent brass rod), spaced 4-inches apart, or from ¼-inch tubing spaced 3.5-inches apart. Alternatively, it wouldn't be too bad if 450-ohm twin-lead were used to connect the two dipoles.

The feedpoint is on the transmission-line harness, mid-way between the dipoles (points X1 and X2 in Fig.

(Continued on page 78)

Explore the past and present advancements made in this popular hobby, and learn how you can get started in it.



TOY TRAINS

BY DENNIS EICHENBERG

The toy-train market is exploding because of electronics. That's because electronics technology has provided the "new" toy trains with a functionality and reliability never dreamed of in the past. And it's just getting started.

The toy-train hobby is a wonderful way to combine the nostalgia of yesterday with the high technology of today. It's something that grandparents, parents, and children can all participate in. The hobby provides a creative release, an application for electronic circuits, and perhaps even an introduction to electronics. It's not surprising to most that the hobby has its benefits; however, few know just how long the pastime has been around.

The Beginnings. Electric toy trains became commercially available in the United States in 1896 when Carlisle and Finch of Cincinnati offered a battery-powered trolley and track. That was a significant achievement at the time considering that electricity itself was just beginning to be used and understood. In 1897 Marklin of Germany introduced a complete electric train with a locomotive and cars.

Later, in 1901, Joshua Lionel Cowen of Lionel fame developed an electric railroad car called the "Electric Express" as a store-window exhibit. The window exhibit itself became a sensation and sold briskly. Several other firms such as American Flyer, Marx, and Ives soon began producing electric trains. And the hobby was born.

Gauges. There were no standard track widths or gauges when toy trains were first developed. That would change over the years as a number of different standards were developed. It all started in 1907, when Lionel introduced a track with a center rail that had one conductor and two outer rails connected together electrically as the other conductor. The width between the outer rails was 2.125 inches. That was referred to as the three-rail Standard Gauge and quickly became the American standard of the time.

Ives then made available, in 1910, O Gauge electric trains in which the width between the outer rails was 1.25 inches. Lionel also offered O Gauge trains in 1915, along with their Standard Gauge trains. O Gauge trains are still very popular, with many manufacturers constantly introducing new products for the line.

Next, OO Gauge trains, with a rail spacing of 0.75 inches, were made available in the 1930s. Also introduced in the 1930s were HO Gauge trains, with a rail spacing of 16.5 mm; HO Gauge is the most popular gauge in use today.

Things were then quiet until after World War II, when American Flyer developed two-rail S Gauge trains, which have a rail-spacing of 0.875 inches. The availability of S Gauge trains is a bit limited, but they do have a dedicated following and are still being manufactured.

The 1960s brought the introduction of N Gauge trains, which have a rail spacing of 9 mm; that is presently the second most popular gauge. Large Scale or G Gauge trains also became available in the 1960s. Although LGB was the first in 1968 to come out with them, several other manufacturers soon offered G gauge trains. The G Gauge track is 45 mm between the rails; also, the trains are very rugged and well suited for outdoor or indoor use.

Finally, Z Gauge trains were offered by Marklin in 1972. The rail spacing in those units is 6.5 mm. Although that is presently the smallest type of train commercially available, it is remarkably detailed and sophisticated despite its tiny size.

Electronic Evolution. You might be wondering by now just how electronics have improved the toy-train

hobby over the years. Let's take a look at a few of those ways here:

For starters, in the early days of the hobby batteries powered most trains. That could make the hobby quite expensive after a while. All that began to change in 1906 when Lionel offered a train transformer to reduce household voltage to a safe operating voltage. The transformer eliminated the need for batteries and permitted the speed of the trains to be easily adjusted.

Many early trains used universal AC/DC motors in which the field winding was in series with the armature winding. A manual switch was then provided on some of the locomotives to permit the reversing of the motor by switching the phase between the field and armature windings. In 1924 Ives introduced remote-controlled reversing, which allowed a train to go forward, then pause, then reverse, then pause, and then go forward simply by interrupting the train power. The schematic for the reversing unit is shown in Fig. 1. It has become the standard reversing scheme, and many toy trains still use it today.

Of course, changing a motor's direction is not the only control a hobbyist would like to have over a train. That's why a remote-controlled switch track was introduced by Lionel in 1927. The switch track was activated by a miniature solenoid installed in the switch—a method that's still commonly used.

Lionel also introduced a remote-controlled train whistle in 1935. It consisted of a motorized fan that sent air through resonating chambers that were tuned like an organ. The whistle was controlled by a small DC current from the transformer, which activated a relay that was pulled in by DC only. Because the train was operated from AC, it was not affected by the whistle. The schematic for the whistle is shown in Fig. 2.

A further advancement was made by Lionel in 1936, when it introduced the remote-controlled coupler. The coupler included a miniature solenoid that was energized by a pickup from a special track section. Later the special track section included an electromagnet that activated the coupler mechanically. That latter method proved to be very reliable, and is still commonly used.

Smoking steam locomotives were

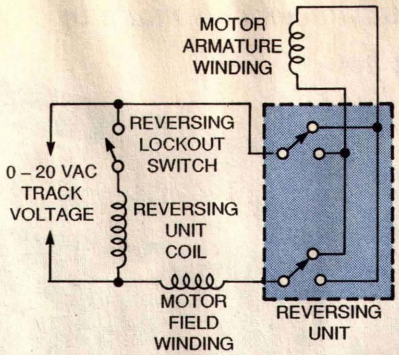


Fig. 1. This Ives circuit permits the reversing of the train motor by switching the phase between the field and armature windings.

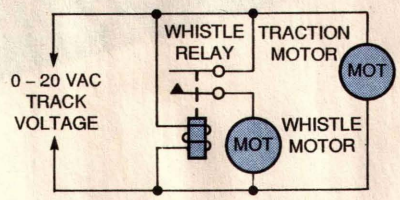


Fig. 2. This whistle circuit is controlled by a small DC current, which activates a DC relay and whistle motor. The train, which runs on AC, is not affected by the whistle.

introduced by Lionel in 1946. Such a train had a special lamp that would heat a pellet inserted into its smokestack. The following year the lamp was replaced by a nichrome wire and bellows synchronized with the wheels, which provided puffs of smoke as the train moved. That advanced system is still in use.

A different kind of electronic train set was offered by Lionel in 1947. The set had a vacuum-tube radio transmitter with two rows of colored buttons. The locomotive and tender, and the cars, each had a colored dot that matched the transmitter buttons, along with a receiver tuned to the particular frequency of the transmitter. That system permitted the train to be controlled anywhere on the track at any time without any special track sections or extra wiring.

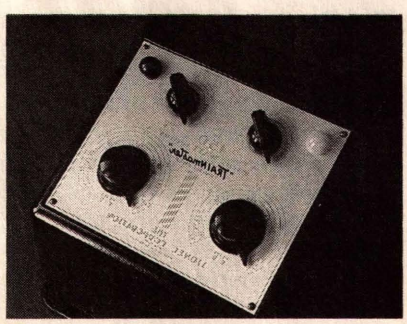
As you can tell so far, some accessories are necessary for making a train set work better, while some are just for show. Of course, electronic accessories that enhance the appearance of a kit are part of what makes the hobby so enjoyable, and for that reason they have always been popular with toy-train owners. Simple add-ons like lamps and signals were available from the beginning. Then, in 1935, Lionel introduced an operating watchman that jumped out of a shed when the train passed. The watchman was activated by a solenoid installed in the shed. This was the first of many animated accessories, and is still produced today.

Control Systems. One challenge of train control is enabling several individuals to operate trains independently on a layout. The classic approach is to divide a track into several electrically isolated sections or blocks. On a large layout, though, the wiring becomes quite complex. For that reason, computers have been used on many layouts to ease the burden.

Computers permit trains to be programmed for any motion profile desired. Locomotive specifications, loads, and even weather conditions can be programmed to provide realistic train operation.

A further development is a standard protocol for toy trains developed by the National Model Railroad Association (NMRA). Called digital command control (DCC), the protocol is compatible with two- and three-rail systems. It is essentially a local area network (LAN), which uses the track rails to carry the signals. All data pertaining to the train, such as acceleration rate, deceleration rate, and load can be downloaded from a central controller to the integrated circuit installed in the locomotive. Therefore, DCC permits several locomotives to run simultaneously on the layout, all on the same track, without blocks, and individually controlled by one or more operators.

As shown in Fig. 3, DCC is a pulse-width modulated system. Controllers



This 1906 Lionel transformer eliminated the need for batteries and permitted the speed of toy trains to be easily adjusted.

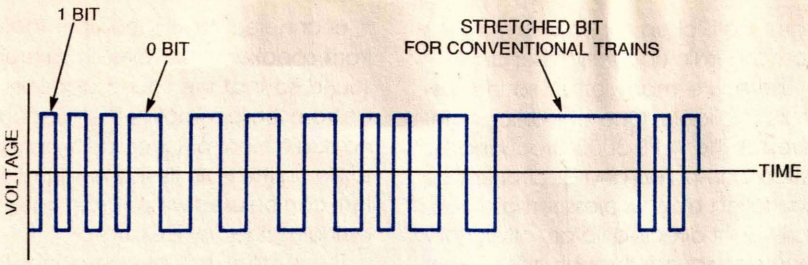


Fig. 3. As shown here, DCC is a pulse-width modulated system. Controllers transmit power and data in the same signal, and a decoder aboard the locomotive then extracts the information.

transmit power and data in the same signal, and a decoder aboard the locomotive then extracts the information. Each DCC signal has an address byte, an instruction byte, and an error byte. A typical system can have up to 99 addressable locations, which are upgradable to 32,000. Address locations are established in software during a two-way cycle that the train acknowledges by providing a momentary low impedance across the track. All other communications are one-way from the controller to the train.

Transmitted instruction bytes contain speed and direction commands. The baseline packet permits 14 speeds, which are upgradable to 128.

CLUBS

LGB Model Railroad Club
P.O. Box 15835
Pittsburgh, PA 15244-5835

Lionel Collectors Club of America
P.O. Box 479
La Salle, IL 61301

Lionel Operating Train Society
P.O. Box 62240
Cincinnati, OH 45262-0240

Lionel Railroader Club
P.O. Box 748
New Baltimore, MI 48047-0748

Marklin Club
P.O. Box 51559
New Berlin, WI 53151-0559

Marklin Digital Club
P.O. Box 51559
New Berlin, WI 53151-0559

National Model Railroad Association
4121 Cromwell Rd.
Chattanooga, TN 37421

Toy Train Operating Society
25 W. Walnut St., Suite 308
Pasadena, CA 91163

Train Collectors Association
P.O. Box 248
Strasburg, PA 17579

There are also software packages available to calibrate the trains. Such software runs a train through its paces to establish a speed/voltage table; the table is then downloaded to the trains so that a speed command from the central controller goes to the look-up table of the train to provide the correct operating voltage.

Conventional trains can also be operated with a DCC system. In this case the zero bit is stretched to impose an average positive voltage on the track to provide operating power.

The NMRA DCC Standards and Recommended Practices address a total of nine output functions. That permits a train's front and rear headlights to be turned on and off, while also being able to dim the headlight, and operate the Mars light, strobe lights, ditch lights (both constant on and alternating), classification lights, number boards, and sound module.

Also available are DCC switch decoders that permit switch tracks to be operated remotely from the controller. An operator can customize the timing settings of each switch track after it is installed in the layout.

In 1994 Lionel introduced the TrainMaster system, which is a transformer and remote-control system. It provides wireless walk-around control, multi-train operation, and realistic train-speed control. The TrainMaster system can either control the track voltage for operating conventional trains, or function as a Command Control that provides a constant track voltage and controls a digital receiver in each train.

In the TrainMaster control mode, up to ten trains can be operated on separate blocks. There is one wireless remote-control unit, one receiver for each block, and one transformer. The remote-control unit has a range of 150 feet. Any Lionel or Lionel-compatible sound system can be operated by the TrainMaster.

The TrainMaster system provides realistic acceleration and deceleration of the trains. Also, a "Big Red" pushbutton can be connected to permit control of the system by young children or the physically challenged.

OPERATING LAYOUTS

America's Railroads on Parade
1915 Pocahontas Trail, Suite A-4
Williamsburg, VA 23185

Choo-Choo Barn
Rt. 741 E.
P.O. Box 130
Strasburg, PA 17579

The Detroit Historical Museum
5401 Woodward Ave.
Detroit, MI 48202-4097

Lionel Trains Visitor's Center
Lionel Trains, Inc.
Chesterfield, MI 48051-2493

Nassau Lionel Operating Engineers, Inc.
Medical Arts Bldg.
Walcott Rd.
Levittown, NY 11756

The New York Botanical Garden
200th St. & Southern Blvd.
Bronx, NY 10458

Oglebay Miniature Railroad & Village
Oglebay Resort & Conference Center
Wheeling, WV 26003

Railway City USA
Rt. 236
Kitter, ME 03904

Train-O-Rama
6832 E. Harbor Rd.
Marblehead, OH 43440

Trainland USA
3135 Highway 117 N.
Colfax, IA 50054

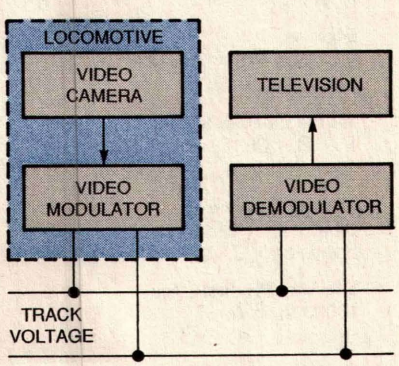


Fig. 4. In the Lionel Rail Scope system, a miniature electronic video camera is mounted inside a toy train. The video signal is transmitted from the locomotive over the rails to a receiver that is also connected to the rails.

In the TrainMaster Command Control mode, a receiver connected to the track translates the command from the wireless remote control unit into a digital code transmitted over the track. Each locomotive has a receiver that translates the digital code to control multiple Command Control-equipped trains on the same track simultaneously and independently. It also controls the train's sound system, lighting, and couplers. In addition, the system permits operation of switch tracks and accessories.

Sound. Lionel introduced the Mighty Sound of Steam in 1972. This was an electronic sound system with a miniature speaker in the locomotive to provide a synthesized locomotive sound; it proved to be quite effective. Lionel took that sound technology a quantum step forward when it introduced their Railsounds in 1989. It provides a digital recording of the actual prototype. Thus a realistic whistle, horn, bell, chug, or roar emanates from the train upon command.

There are many other sound systems available. One of particular interest is the ALPS-3000 produced by Witco Computers and Electronics. It is controlled by a wireless remote controller that directs a library of digitally recorded sounds through any of eight amplified surround channels and strategically placed speakers, making it possible for the appropriate sounds to originate anywhere on the layout.

When the train is ready to depart the station, a press of a button will cause the conductor to shout "Board" from inside the station. Then, it's possible to ring the locomotive's bell, vent steam, chuff, and head for the main line. You can press other buttons to hear running water from a stream bed, ring a church bell, make the cows moo, or listen to the saws and hammers of a work crew. The speed-synchronized sound of the locomotive is channeled along the line, fading from speaker to speaker in surround sound so that the sound appears to be from the locomotive itself. Because no audio electronics or speaker need to be on the train itself, the sound system can be used with all train gauges, including the tiny Z Gauge.

The system is highly expandable permitting hundreds of sounds to be added. Also, a live microphone input is provided to permit customized messages to be produced.

Other Recent Developments. Lionel introduced the Rail Scope system in 1989. In it, a miniature electronic video camera is mounted inside a specially outfitted locomotive (available in every gauge), allowing the operator to see the layout on a television as the engineer would. A block diagram of the system is shown in Fig. 4. The video signal is transmitted from the locomotive over the rails to a receiver that is also connected to the rails. The signal from the receiver is then taken by wire to the television.

High technology is also being applied to track cleanliness. For reliable train operation it is essential that the track is kept clean to maintain electrical conduction. That can be an exhaustive physical task on a large layout. To facilitate track cleaning, Miniatronics manufactures an electronic track cleaner. Called Electrak Clean, it superimposes a high-frequency signal on the normal track voltage to ionize the gap due to contamination, and restore electrical conduction.

Software has also become important in the toy-train industry. One company, Sandia Software, produces a layout design program called Cadrail. It includes libraries for many different gauges so that a virtual layout can be developed prior to purchasing any hardware.

Future Developments. There are several areas of toy-train technology currently being developed that will become commercially available in the future. One is from Motorola, which manufactures a family of integrated circuits used in automation systems called neurons. Neurons use an ethernet type of system to provide inexpensive two-way communication when installed in trains. Thus the trains

TRAIN SOURCES

Aristo-Craft
346 Bergen Ave.
Jersey City, NJ 07304

Atlas Tool Co. Inc.
378 Florence Ave.
Hillside, NJ 07205

Bachmann Industries, Inc.
1400 East Erie Ave.
Philadelphia, PA 19124

Chicago Model International
855 Skokie Valley Rd.
Suite L
Lake Bluff, IL 60044

Dallee Electronics
P.O. Box 1921
Reading, PA 19603

Digitrax
P.O. Box 1424
Norcross, GA 30091

K-Line Electric Trains
P.O. Box 2831
Chapel Hill, NC 27515

LGB of America
6444 Nancy Ridge Dr.
San Diego, CA 92121

Life-Like Products, Inc.
1600 Union Ave.
Baltimore, MD 21211

Lionel Trains, Inc.
50625 Richard W. Blvd.
Chesterfield, MI 48051-2493

Marklin, Inc.
P.O. Box 51319
New Berlin, WI 53151-0319

Marx Trains, Inc.
209 E. Butterfield Rd., #228
Elmhurst, IL 60126

Miniatronics
561-K Acorn St.
Deer Park, NY 11729

Model Rectifier Corp.
2500 Woodbridge Ave.
Edison, NJ 08817

MTH Electric Trains
9693 Gerwig Ln.
Columbia, MD 21046

OTT Machine Services, Inc.
P.O. Box 1701
Lombard, IL 60148-8701

Right-Of-Way Industries, Inc.
1145 Highbrook St.
Akron, OH 44301

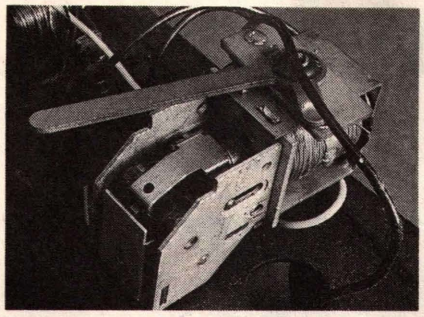
Sandia Software
9428 Tasco NE
Albuquerque, NM 87111

Tyco Industries, Inc.
540 Glen Ave.
Moorestown, NJ 08057

Wangrow Electronics, Inc.
P.O. Box 98
Park Ridge, IL 60068-0098

Weaver Models
P.O. Box 231
Northumberland, PA 17857

Witco Computers & Electronics
3563 Sueldo St., Bldg. B
San Luis Obispo, CA 93401



Reversing units for AC-powered trains, like the one shown here, are basically solenoid-operated drum switches.

will be able to "talk" to each other as well as to the controller.

Also, even though Z Gauge trains are now the smallest commercially available units on the market, further miniaturization is being considered. Extremely tiny motors have already been developed that will permit even smaller trains if a market exists for them. Of course, part of the fun of the toy-train hobby is still having a large, visually pleasing setup.

Getting Started. Now is the ideal time to enter or reenter the world of toy trains. Trains from the past can be used to get started, and you can then supplement them with the high-tech marvels of today as time and money permit. The compatibility of modern equipment prevents the obsolescence of older train equipment. Before jumping in to the hobby, though, you might want to try familiarizing yourself with it in one of the following ways:

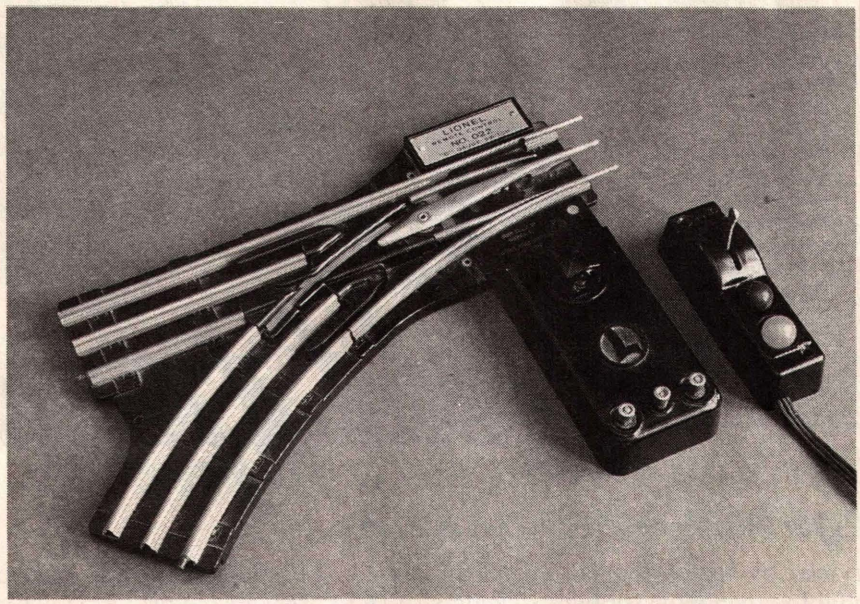
First, try attending a train show. Several shows are scheduled in every city each year; watch your local papers for scheduled times and places. The shows provide an opportunity to talk to several different suppliers about their equipment. Also, operating layouts are usually displayed at the shows.

Another way to get familiar with the hobby is to contact a toy-train club. Many of them have local organizations with regular meets that permit members to discuss their particular concerns and interests. A lot of the clubs have operating layouts in which the members take an active role. That is a perfect solution for apartment dwellers who desire to work on a toy railroad. A list of some of the clubs is included in the "Clubs" box.

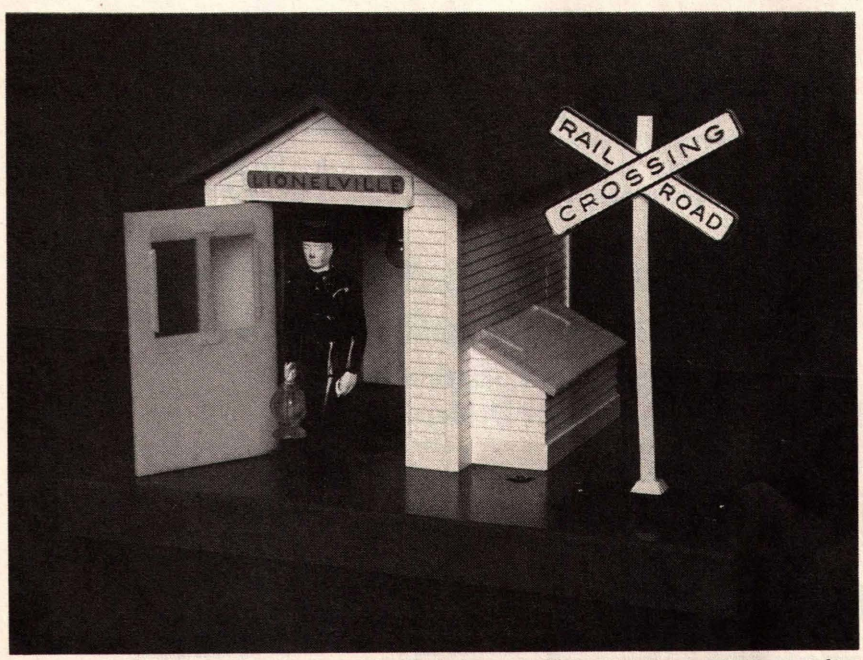
Want still another great way to get introduced to toy trains? Why not visit one of the many operating layouts throughout the country that are open to the public. Such displays provide an excellent way to see what kind of trains and layouts hold the greatest appeal to you. A list of some of those layouts is included in the "Operating Layouts" box.

Finally, you'll probably want to find out about the actual trains and accessories you'd have to buy. A list of some toy-train sources is included in the "Train Sources" box. Contact them for additional information on their products. Most manufacturers' literature provide a wealth of knowledge on what is available in the hobby and where the hobby is directed. Of course, the literature will also give you an idea of how much you can expect to spend on your new hobby.

The possibilities in the world of toy trains are endless, especially for the electronics hobbyist. It is an excellent forum in which to apply electronic circuits to enhance the trains' functionality, reliability, and appearance. ■

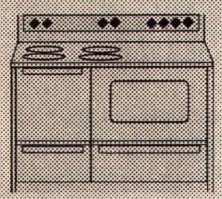


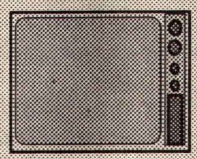
This remote-controlled switch track is activated by a miniature solenoid. Many train sets still use this same method.

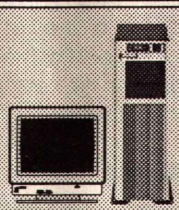


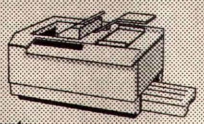
This operating watchman jumps out of his shed whenever a toy train passes. It was the first animated accessory ever produced for a toy train.

Where Do I Go When It Doesn't Work?



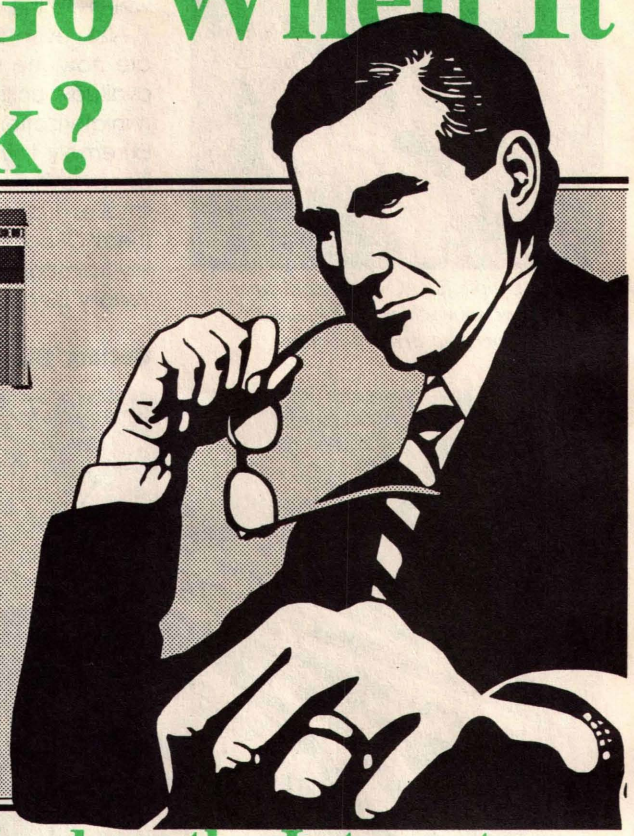






- Answering Machines
- Appliances
- Audio Equipment
- Camcorders
- Cellular Telephones
- Computers
- Computer Monitors
- Copy Machines
- Clothes Dryers
- Electronic Musical Instruments
- Fax Machines
- Home Automation
- Home Theatre
- Microphones
- Microwave Ovens
- Printers
- Radar Detectors
- Radios
- Satellite Receivers
- Security Systems
- Speakers
- Telephones
- Televisions Sets
- Vehicular Electronics
- Video Games
- Washing Machines

Guaranteed Quality Service for All Your Computers, Office Machines, Appliances, and Consumer Electronics Products.



Find the Service You Need on the Internet at http://www.nesda.com

You deserve to have your equipment serviced by professionals in product service. National Electronics Service Dealers Association (NESDA) and National Independent Appliance Dealers (NIAS) presents a worldwide listing of competent, professional independent appliance, computer, consumer electronics, and home-office product service centers. All are pledged to provide quality service and adhere to a comprehensive code of business ethics. at NESDA.com on the worldwide seb, you will:

- ☑ Find out how to get good service — every time
- ☑ Find a nearby quality, ethical, professional service center by zip code now
- ☑ Get advice on service contracts and extended warranties
- ☑ Learn how to file a complaint
- ☑ Arrange a service appointment to meet your schedule
- ☑ Phone, fax, or send an e-mail message to a participating service center or visit their worldwide web site
- ☑ Get more useful information

Soon to Come:

- ☐ Select by your product type
- ☐ Select by the product's brand-name
- ☐ Select the factory-authorized service centers for your product and brand
- ☐ Get product pruchasing advice

Have Your Equipment Repaired and Maintained by the Ethical Professionals in Product Service

National Electronics Service Dealers Association (NESDA) and National Independent Appliance Dealers (NIAS)

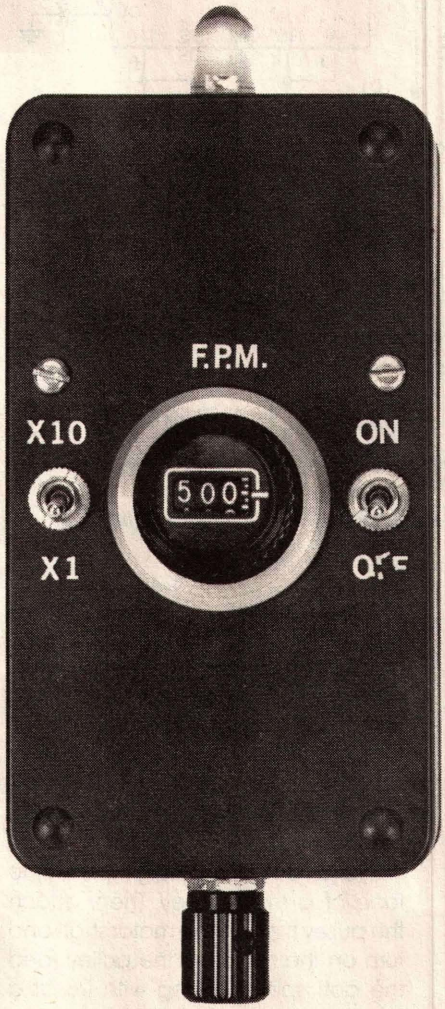
A worldwide listing of competent, professional independent appliance, computer, consumer electronics, and home-office product service centers. Pledged to provide quality, service, and adhering to a comprehensive code of business ethics.

http://www.nesda.com

NESDA.com

2708 W. Berry St., Fort Worth TX 76109; Phone 817-921-9061; Fax 817.921.3741

Build A Solid-State Stroboscope



Use this precision handheld unit to make remote RPM measurements and view moving devices in stop-action.

BY SKIP CAMPISI

Have you ever wanted to have a good look at a rotating or reciprocating mechanical device while it's in high-speed motion? Or perhaps you want to measure the revolutions or strokes per minute of such a device? Well, the easiest way to accomplish that is with a stroboscope; however, commercially available units have their problems. Because they tend to use xenon or neon flash tubes, most stroboscopes require high voltages for triggering. Also, the tubes in them run rather hot and are expensive.

The *Solid-State Stroboscope* described in this article solves those problems by using LED technology. Forget about tubes that need to be replaced, the circuit will drive a super-bright LED, which has an extremely long life. Also, a high-voltage supply is not needed—the circuit uses a 9-volt battery as a power source. Best of all, the Stroboscope can be built for a fraction of what the tube versions cost.

The Stroboscope has two range settings, ×1 and ×10, that cover the 0- to 10,000-FPM (flashes-per-minute) rate. At the ×1 setting, the unit has an accuracy of 1% over the 100- to 1000-FPM range; at the ×10 setting, there is a 1% accuracy over the 1000- to 10,000-FPM range. That enables you to adjust the duration of the flash to fit a particular application. For example, if more brightness is required, use a longer flash; for clearer stop-action, try a shorter flash.

Circuit Description. The schematic diagram for the Stroboscope is shown in Fig. 1. When switch S2 is closed, a 9-volt battery, B1, is connected to IC3, a 78L05 voltage regulator, which provides a 5-volt source to the circuit. Capacitors C8 and C9 filter the supply.

A CD4046 phase-locked loop, IC1, provides a low-frequency square-wave to the circuit. Potentiometer R4—a 5000-ohm, 10-turn, precision potentiometer with a built-in turns counter—provides a way to adjust and get a direct readout of the FPM rate from 0 to 1000. Switch S1 lets you select the multiplier affecting that rate. Setting S1 to ×1 therefore gives you a 0- to 1000-FPM range, while setting S1 to ×10 results in a 0- to 10,000-FPM range. The values of the multiplier settings are determined by capacitors C1 and C2.

A 555 timer, IC2, configured in a monostable mode, provides a pulse with a width that is adjustable via R8. That audio-taper potentiometer allows the duration or pulse width to be varied from 10 microseconds at the minimum setting to 1000 microseconds at the maximum setting.

An MPSA14 Darlington transistor, Q1, is configured as a capacitive discharge-type current sink, which provides an approximately 90-milliampere pulse (for the pulse duration set by R8) through LED1, the flash output. The super-bright LED specified for LED1 has a maximum rating of 100 milliamperes.

Construction. The author's prototype was assembled using perforated board and point-to-point wiring. You can do the same, or feel free to use any other standard project-building method.

Start by mounting sockets for IC1 and IC2, but don't insert the ICs yet. Then, working away from the sockets, wire the resistors and capacitors, making sure that the polarized units are properly oriented. For best accuracy, choose a precise 1.0-µF capacitor for C1 and a precise 0.1-µF capacitor for C2; C1 has to be as close to ten times the value of C2 as possible. For the best linearity, R3 and R5 should both be close to 680 ohms.

Mount trimmer-potentiometer R2. Go on to install D1, D2, and LED2 to the circuit, followed by Q1. Make sure all those components are oriented properly. Leave short, insulated wire leads on the board for LED1, potentiometers R4 and R8, switches S1 and S2, and the negative battery connection. To complete the on-board assembly, install IC3 and then insert IC1 and IC2 into their sockets.

Mount R4, R8, S1, and S2 onto a suitable project enclosure. Then drill a couple of clearance holes for the leads of LED1 on the end of the enclosure. Install the LED to the enclosure using a dab of silicone sealant.

Next, install the board into the enclosure using spacers. Connect all the off-board components to their appropriate leads, and attach the battery snap to the negative battery lead and switch S2.

Calibration and Use. Connect a battery to the snap in the

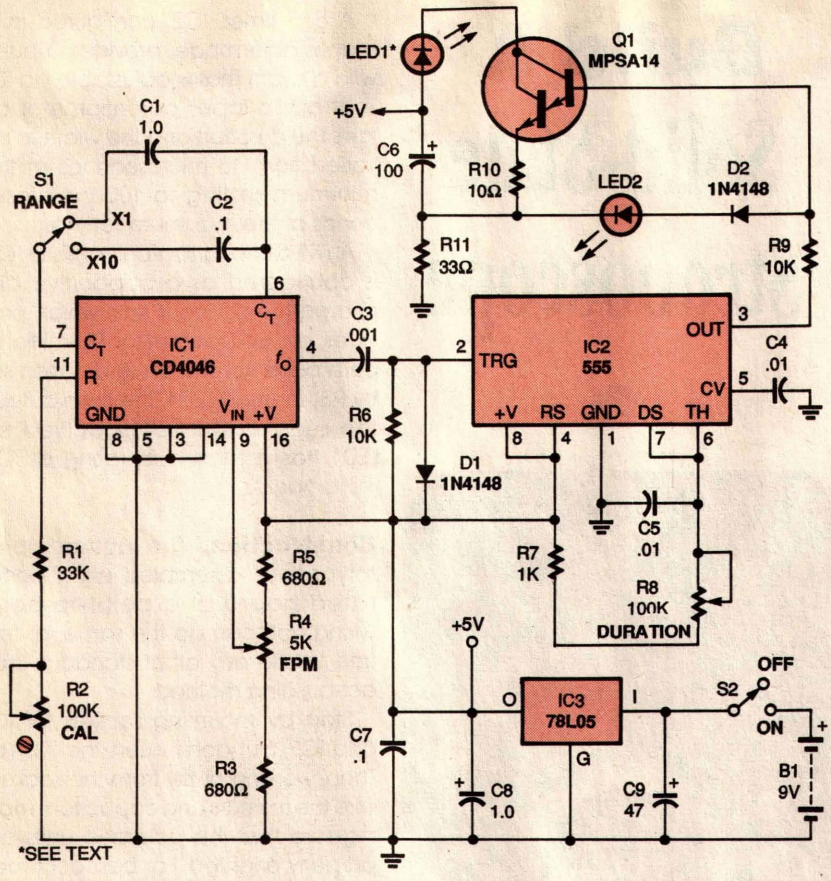


Fig. 1. Here's the schematic for the Solid-State Stroboscope. A super-bright LED, LED1, provides the unit's output.

PARTS LIST FOR THE SOLID-STATE STROBOSCOPE

SEMICONDUCTORS

IC1—CD4046 phase-locked loop, integrated circuit
IC2—555 timer, integrated circuit
IC3—78L05 5-volt regulator, integrated circuit
Q1—MPSA14, 2N6427, or equivalent NPN Darlington transistor
D1, D2—1N4148 silicon switching diode
LED1—Super-bright light-emitting diode, orange, 12,000-mcd, 620-nm (Radio Shack part no. 276-206 or equivalent)
LED2—Light-emitting diode, yellow

RESISTORS

(All fixed resistors are ¼-watt, 5% units.)
R1—33,000-ohm
R2—100,000-ohm miniature trimmer potentiometer, single-turn
R3, R5—680-ohm
R4—5000-ohm precision potentiometer, 10-turn, with built-in turns counter (Bourns #3610S or equivalent)
R6, R9—10,000-ohm
R7—1000-ohm
R8—100,000-ohm audio-taper potentiometer, single-turn
R10—10-ohm
R11—33-ohm

CAPACITORS

C1—1.0-µF, polyester or non-polarized electrolytic
C2—0.1-µF, polyester
C3—0.001-µF, ceramic-disc
C4—0.01-µF, ceramic-disc
C5—0.01-µF, polyester
C6—100-µF, 16-WVDC, electrolytic
C7—0.1-µF, ceramic-disc
C8—1.0-µF, tantalum
C9—47-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

B1—9-volt alkaline battery
S1, S2—SPDT miniature toggle switch
Circuit-board materials, suitable enclosure, battery snap, spacers, IC sockets, control knob, hardware, wire, solder, etc.

Stroboscope. Set the duration-adjust potentiometer, R8, which ranges from 10 to 1000 microseconds, to mid position, or 100 microseconds. Then turn the flashes-per-minute potentiometer, R4, to indicate 900 on its counter. Set the range-select switch, S1, to × 10. With those settings, the unit should output approximately 9000 flashes per minute, although you still need to calibrate the circuit. Turn on the Stroboscope using S2; LED1 should come on. If you rotate R8 back and forth, the brightness of LED1 should vary.

To perform the next part of the calibration you will need a frequency counter. Attach the input leads from the counter between pin 4 of IC1 and ground, and adjust trimmer-potentiometer R2 for a reading of exactly 150 Hz at the 9000-FPM setting. You can test the linearity of the circuit by resetting R4 and checking the frequency again: At 6000 FPM, the reading should be 100 Hz; at 3000 FPM, 50 Hz; and at 1200 FPM, 20 Hz.

Using the Stroboscope is easy once you have a basic understanding of the images you will see at different flash rates. The following example is a description of how to make an actual RPM measurement on a rotating motor. The motor used to test the author's prototype was an 1800-RPM synchronous type running on 115-volts AC; try to use a similar motor for your own test.

Stick a "dot" of masking tape on the face of a small pulley. Then, attach the pulley firmly to the motor shaft and turn on the motor so the pulley (and the dot) spins. Starting with R8 at a duration setting of 1000 microseconds and S1 set to the × 1 range, advance the turns counter from 0 FPM up the scale while observing the image of the "dot" target. You'll see multiple images of the target at many settings; however, look for the settings that only give one single target image. Those occur at whole number divisions of the actual RPM; in the author's case, those were at 1800 divided by 4 (450 FPM), 1800 divided by 3 (600 FPM), and so on until the actual RPM at 1800 FPM was reached.

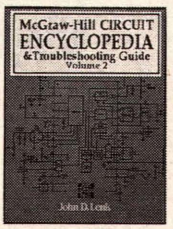
If you continue increasing the FPM setting, you will no longer see a single target image. Rather, at double the RPM rate (3600 FPM) you will see two images at 180-degrees apart; at triple the RPM (5400 FPM) you will see three images 120-degrees apart; and so on up the FPM scale. Noting those readings as you go will help you yield the

5 BOOKS FOR ONLY $4.95

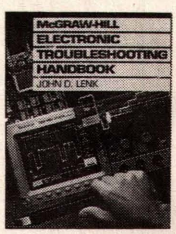
WHEN YOU JOIN THE **Electronics Book Club®**

VALUES TO $162.75

The leading source of information for electronics hobbyists for over 30 years!

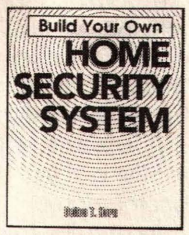


0376115-XX $36.95
Counts as 2/Hardcover

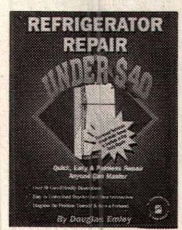


0376581-XX $39.50
Counts as 2/Hardcover

5869195 $12.95



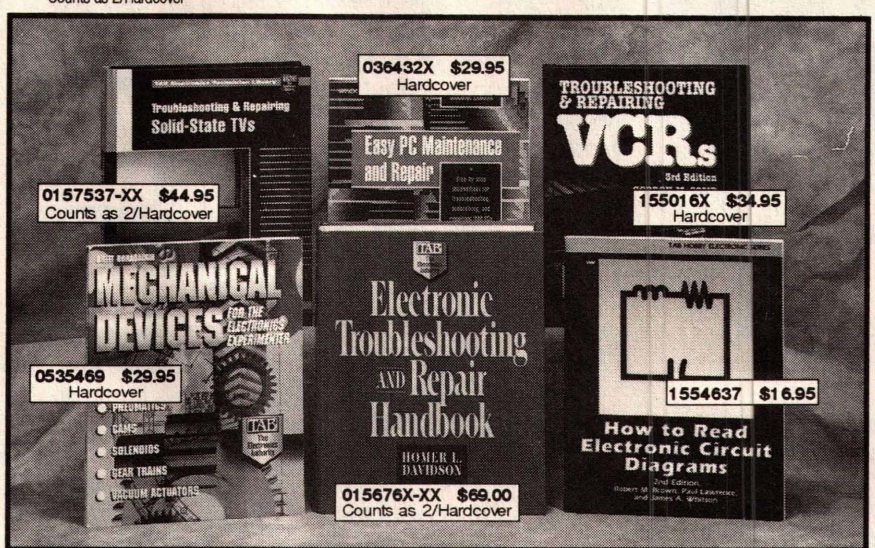
0303932 $17.95

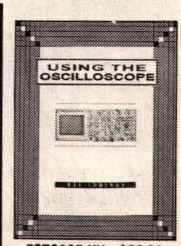


5869179 $12.95

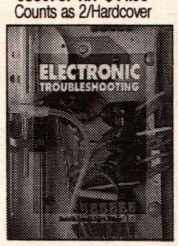
1570519 $17.95

0350787-XX $44.95
Counts as 2/Hardcover

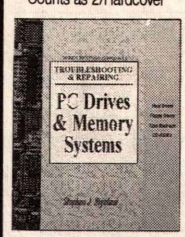




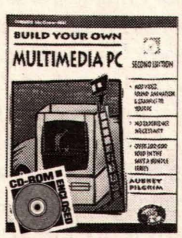
5872625-XX $30.00
Counts as 2/Hardcover



0650780 $24.95

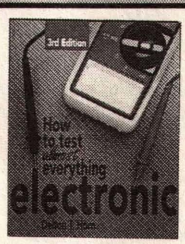


0053146 $24.95

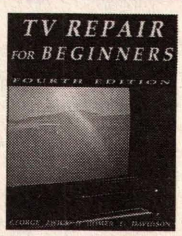


9122264 $39.95

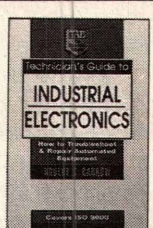
5870606 $12.95



0304068 $15.95

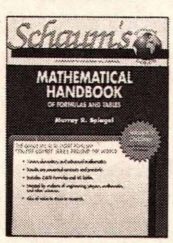


073092X $19.95

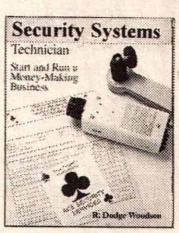


0112738-XX $45.00
Counts as 2/Hardcover

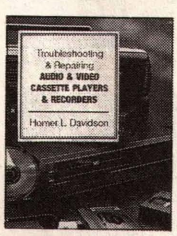
024247X-XX $49.00
Counts as 2/Hardcover



0602247 $13.95

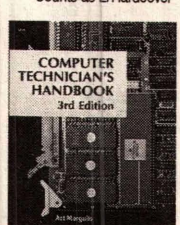


0717753 $19.95

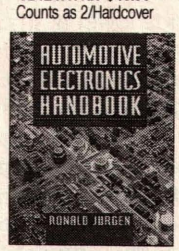


1577564 $22.95

0156492-XX $34.95
Counts as 2/Hardcover



1575472 $27.95

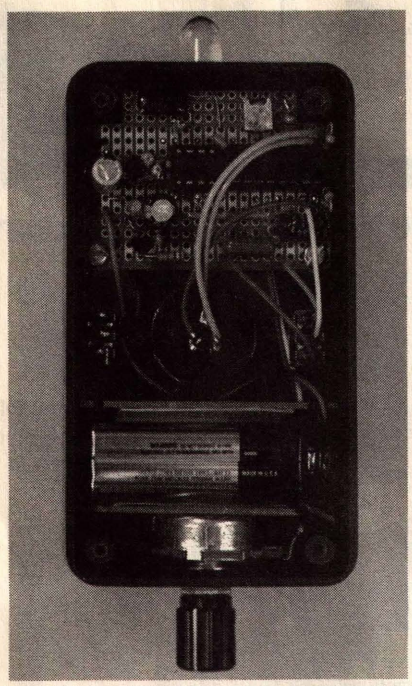


0331898-XX $89.50
Counts as 2/Hardcover

As a member of the ELECTRONICS BOOK CLUB® . . . you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off the regular publishers' prices. If you want the Main selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. Your only obligation is to purchase 3 more books during the next 12 months, after which you may cancel your membership at any time. And you'll be eligible for FREE BOOKS through our Bonus Book Program.

A shipping/handling charge and sales tax will be added to all orders. All books are softcover unless otherwise noted. If you select a book that counts as 2 choices, write the book number in one box and XX in the next. (Publishers' Prices Shown) ©1996 EBC PE996

If card is missing, write to: Electronics Book Club®, *A Division of The McGraw-Hill Companies*, P.O. Box 549, Blacklick, OH 43004-9918



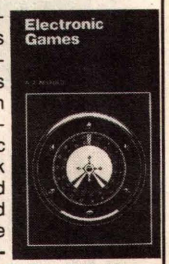
As you can see, the author's prototype was built on perforated board, although any assembly method can be used.

correct RPM rate. Watch for the change from the last single image to the double image. The former FPM rate should match the RPM rate of the motor, while the second FPM value should be exactly twice the actual RPM of the motor.

As with all strobes, the best results are obtained in a darkened room, with the unit just far enough away to cover the target area with the flash. That is of particular importance when using short flash durations (less intensity), which is what you should normally do for most stop-action photography.

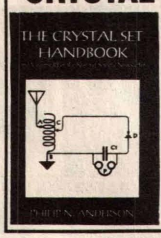
The maximum-duration or brightest setting gives excellent results when doing RPM measurements, even in a normally lit area, as a slightly blurred image is of no consequence. Due to the natural divergence of the light beam from the LED, you can vary the area of light coverage just by altering the distance between the Stroboscope and target. ■

ELECTRONIC GAMES



BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send **$8.00 (includes s&h)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA07

Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only **$10.95** plus **$4.00** for shipping and handling. **Claggk Inc., P.O. Box 4099, Farmingdale, NY 11735.** USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01

UNLOCK-TOO

(Continued from page 40)

volts), gray (also to actuators) and blue (to the lock switch). Due to occasional production changes always verify pertinent wire functions with a test light or similar means.

The location of the relay in the vehicle varies from model to model. To identify the platform of your vehicle check the fourth digit of the vehicle identification number as seen through the left lower corner of the windshield. For vehicles with the letter N the relay is near the parking-brake control assembly. Remove the left-side lower hush panel for access. Vehicles with the letter W have the relay in the right-side electrical-center area behind the passenger-side, lower hush panel. Those vehicles with the letters J and A have the relay behind the glove box, to the right, and fastened to the inner body behind moisture-barrier tape.

Here are some tips on Chrysler vehicles: Most use two separate relays in a relay center located near the fuse block. Also, certain later models have computer-controlled lock systems. In vehicles like that, you'd have to add a small SPST relay to the Unlock-Too. Use the manufacturer's service publications for your model for exact details on where you can place the contacts. But no matter what vehicle you own, check with service publications for your model if there is any question on operation or parts placement.

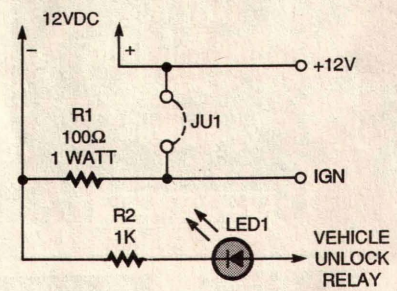


Fig. 4. This simple test circuit will help you determine if your Unlock-Too circuit is working, before you install it.

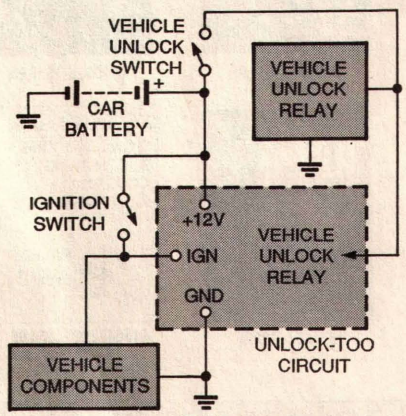


Fig. 5. Although all vehicle electrical systems differ, this connection diagram should help you figure out how to install the Unlock-Too. If you are uncertain about a connection, refer to your vehicle's service publications.

To make the connections shown in Fig. 5, you will need to make splices. That is, instead of cutting the wires in the vehicle's electrical system, simply peel back some of the insulation, attach the appropriate Unlock-Too lead, solder the connection, and insulate it with electrical tape. Another way to make the connections is to use 3M Blue Scotch Lock connector splices. When making the splices, keep in mind that open-circle and arrow connection points shown inside the dashed box in Fig. 5 correspond to the matching points on the circuit board.

Once you've made all the connections as shown, test the installation by turning on the ignition. Manually cycle the door locks with the vehicle switches making sure the last operation locks the doors. Next, turn off the ignition. The doors should automatically unlock. If any operation is incorrect, check that wire splices are secure and properly placed. After you are sure that the Unlock-Too is operating correctly, tape the unit in place to a harness. ■

Circuit Circus

Timing is Everything

CHARLES D. RAKES

Time. That's what we're about this visit.

A young ham friend came by the other day and wanted a simple delay timer circuit for one of his top-secret projects. Knowing Jack (not his real name) from his past fiascoes, and not wanting to be directly involved in his ongoing project, I offered him the following timer circuits to choose from. The same offer holds for you, fellow circuiteers. I hope one or more of these circuits might be useful to you too.

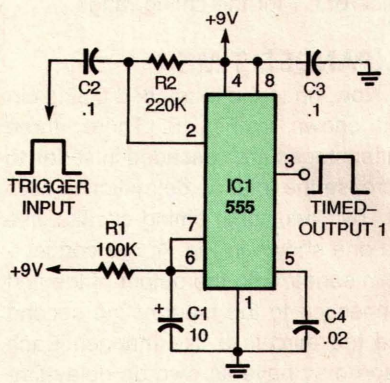


Fig. 1. This simple timer is based on a 555, which is the most well-known IC suitable for this application.

PARTS LIST FOR THE SIMPLE 555 TIMER (Fig. 1)

CAPACITORS
C1—10-µF, 35-WVDC, electrolytic
C2, C3—0.1-µF, ceramic-disc
C4—0.02-µF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS
IC1—555 timer, integrated circuit
R1—100,000-ohm, 1/4-watt, 5% resistor
R2—220,000-ohm, 1/4-watt, 5% resistor
Power source, wire, solder, etc.

SIMPLE 555 TIMER

Because Jack had not been exposed to many timer circuits, I wanted to start him out with the all-time wonder chip, the 555, and let him chew on it first. Mainly because there's so much available information on this IC, I figured it could keep him out of trouble and busy for days just looking for the perfect circuit arrangement.

This simple 555 timer, shown in Fig. 1, is a negative-triggered, timed-on circuit. The values of R1 and C1 determine the on-time period, which can vary from a few microseconds to over an hour. The output of the 555 (pin 3 of IC1) during the on-time period is high and will source up to 200 mA.

To lengthen the on-time period, either or both C1 and R1 can be increased in value. For long time periods when large capacitor values are used, the timing capacitor must be of high quality with minimum internal leakage.

Two or more timer circuits may be cascaded in series for extended time on operation. Just connect the output of the first timer (pin 3) to the trigger input of the second timer circuit, and repeat for each additional stage.

DUAL TIMER

If one 555 is so useful, then why not two in the same package? That same question must have come to IC manufacturers, as they came out with the 556, which is a dual 555 in one 14-pin package.

The dual timer shown in Fig. 2 uses the 556 (IC1) in a cascade timer circuit. The first timing period is set by the values of R1 and C5, and the second timing period by R4 and C6.

The first timer is set for a short timing period of about 1 second, and the second timer for a period of about 10 seconds. When the first section times out, the output at pin 5 goes low, triggering the second section on for its preset on-time. Varying the timing of each section is as simple as replacing R1 and R4 with 1-megohm potentiometers.

The timer's output may be used to drive relays and lamps with operating currents up to 200 mA. Both 555 and 556 timers can be used to sink current up to 200 mA when a timer circuit is at rest or in the timed-out mode.

CMOS CASCADE TIMER

Our next timer, see Fig. 3, uses a CMOS dual retriggerable monostable IC, the 4528, in a cascade timer circuit. Timing-components R3 and C1 set the on-time period of the first timer section (IC1-a), and R4 and C2 perform the same function in the second timer section (IC1-b).

Here's how the circuit operates: Momentarily pressing S1 triggers the

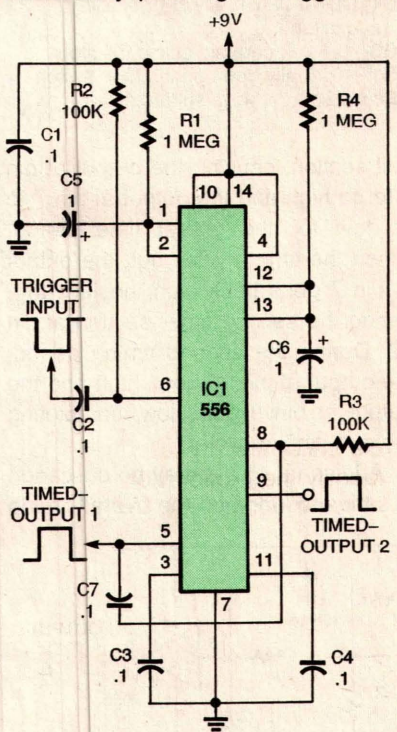


Fig. 2. Two are sometimes better than one. This dual timer contains a 556 IC, which contains two 555 timers in one package.

PARTS LIST FOR THE DUAL TIMER (Fig. 2)

IC1—556 dual timer, integrated circuit
R1, R4—1-megohm, 1/4-watt, 5% resistor
R2, R3—100,000-ohm, 1/4-watt, 5% resistor
C1-C4, C7—0.1-µF, ceramic-disc capacitor
C5, C6—1.0-µF, 35-WVDC, electrolytic capacitor
Power source, wire, solder, etc.

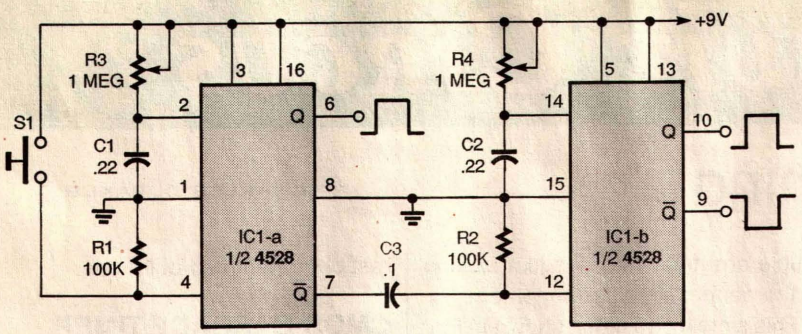


Fig. 3. The CMOS timer shown here can easily be cascaded with other similar 4528 circuits.

PARTS LIST FOR THE CMOS CASCADE TIMER (Fig. 3)

IC1—4528 dual retriggerable monostable, integrated circuit
R1, R2—100,000-ohm, 1/4-watt, 5% resistor
R3, R4—1-megohm, 1/4-watt, 5% resistor
C1, C2—0.22-µF, Mylar or similar capacitor
C3—0.1-µF, ceramic-disc capacitor
S1—Normally open pushbutton switch
Power source, wire, solder, etc.

first section, causing the output at pin 6 to go high and the output at pin 7 to go low for the preset time period. When the timer cycles out, the output at pin 7 goes back high, positive-triggering the second timer section at pin 12. During the second timing period, the output at pin 10 goes high and the output at pin 9 goes low, completing the dual timing cycle.

Additional 4528s may be cascaded in series to lengthen the overall timing cycle. Pins 6 and 7 may be tied together through 1N914 diodes to add the two output times. Connect the anode of one diode to pin 6 and the anode of the other diode to pin 7, and connect the diodes' cathodes together for the total time output.

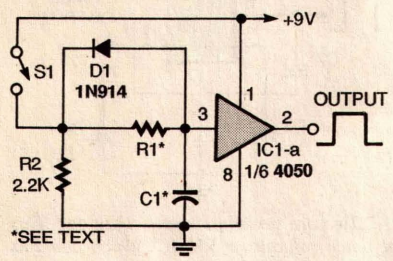


Fig. 4. Want a simple timer at practically no cost? Depending on what parts you have on hand, you can build this circuit for less than a dollar.

PARTS LIST FOR THE CHEAPIE TIMER (Fig. 4)

IC1—4050 hex buffer, integrated circuit
D1—1N914 silicon diode
R1—1/4-watt, 5% resistor, see text
R2—2200-ohm, 1/4-watt, 5% resistor
C1—See text
S1—SPST switch

CHEAPIE TIMER

Now that we got the conventional timing circuits out of the way, let's take a look at something a little different in timer-circuit design. The basic timer circuit shown in Fig. 4 consists of one section of a low-cost 4050 hex noninverting buffer IC, two resistors, a capacitor, and one diode. Depending on what parts you have on hand, you should be able to build it for less than a dollar.

The circuit operates like this: When S1 is closed, C1 begins to charge through R1 toward the 9-volt supply. When the voltage at the input of the buffer, pin 3, reaches about 70% of the supply voltage, the output switches high for an on-time delay function. As long as S1 remains closed, the circuit will maintain the high output at pin 2. Opening S1 resets the timer by allowing C1 to discharge through D1 and R2.

The timing-component values of R1 and C1 may be selected for almost any time-delay requirement. Because an RC time constant of 63.2% is very close to the 70% switching voltage of the 4050 buffer, we can use the standard RC time constant in determining the values of R1 and C1.

Multiply resistance in megohms and capacitance in µF for the RC timing value. A 1-megohm resistor and a 1-µF capacitor gives an RC timing value of 1 second. If a 10-megohm resistor and a 0.1-µF capacitor are used, the RC timing would also be 1 second. If the capacitor is increased to 10 µF and the resistor to 10 megohms, the timing period would be 100 seconds. For variable timing, replace R1 with a potentiometer and select the value of C1 for the timing range.

EXPANDED TIMER

Now, on to the expanded timing circuit shown in Fig. 5. There, three buffer stages are cascaded in series to increase the total on delay-timing period. Two additional timing circuits, like the one shown in Fig. 4, are connected in series, with the output of the first connecting to the input of the second and the third in a like manner. Each stage may have its own on delay-timing period, and can furnish a positive switched output to an external circuit. In this case an LED is connected to each of the timer's outputs as a status indicator.

The expanded timer only uses three of the six buffers in the 4050. If

continued on page 60

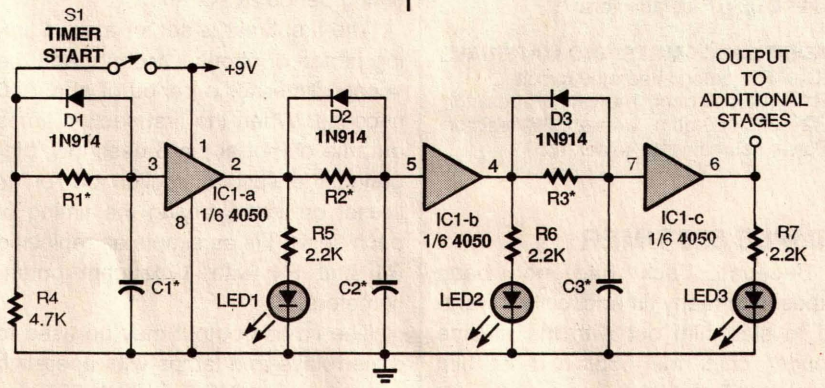


Fig. 5. This circuit is essentially three buffer stages, each similar to the one shown in Fig. 4, that are cascaded in series.

SCANNER SCENE

Monitoring Mickey Mouse

BY MARC SAXON

Pity the scanner owner who, in search of the best, buys an expensive, advanced-technology scanner—even though his monitoring style doesn't require its overkill of fancy operating features. RadioShack to the rescue! Their PRO-2039 is a really good desktop scanner for the action-band adventurer who wants performance, but without paying for sophisticated features that probably will never be put to use.

The rig offers 200 memory channels arranged in ten banks of 20 each. There are another ten "scratch-pad" monitor memories for temporary storage of new frequencies discovered during searching excursions.

Frequency coverage is 30 to 54 MHz, 137 to 174 MHz, 380 to 512 MHz, and 806 to 960 MHz, plus the 108 to 137-MHz VHF aeronautics band. The two cellular bands are locked out at the factory and cannot be user-restored. The PRO-2039 can be switched to scan at either of two speeds: 8 or 24 channels per second. Similarly, it can search at either 8 steps per second or 50 steps per second.

Standard amenities include a priority channel, two-second delay, lockouts, an LCD readout, and a full hour of memory backup under power-loss conditions.

The IF frequencies are 10.7 MHz and 455 kHz. Selectivity at ±10 kHz is –6 dB, and at ±20 kHz, it's –50 dB. Sensitivity is 0.5 μV below 50 MHz, 1.0 μV between 137 and 512 MHz, and 2.0 μV on the VHF aeronautics and 800-MHz bands.

You can ogle the smart-looking PRO-2039 at any of RadioShack's 7000 retail outlets.

TAKE ME ALONG!

It's great to visit those spectacular Central Florida tourist attractions. Readers tell us that they are bringing along handheld scanners so they can enjoy the behind-the-scenes action while they spend their money—or while waiting on those long lines. That sounds reasonable enough, although it is possible that the use of handheld scanners is not permitted everywhere. Those attractions are private property, and they do have the right to ask you not to bring in a scanner. If they don't allow scanners, you can always chance it anyway, or just listen from your motel room.

For the many readers who asked about frequencies at Universal Studios, try these: 451.75, 461.125, 461.2875, 461.7125, 461.8875, 462.0125, 462.1125, 463.3875, 463.5875, 463.6125, 463.6375, and 463.6625 MHz.

Some of the better frequencies at and around Walt Disney World are believed to be: 464.125 and 464.40 MHz for security; 461.30 MHz for parades; 461.60 for Fort Wilderness; 462.625 MHz for the Magic Kingdom; 462.55 for the Monorail; 464.20 MHz for the resort; 462.65 for EPCOT; and 151.895 for 20,000 Leagues. The Hilton at Disney World is on 461.6875, 461.7125, 463.8125, 464.525, and 469.9375 MHz. The Walt Disney World Dolphin Hotel uses 464.525, 464.675, and 464.825 MHz.

Nickelodeon Studios uses 462.10, 464.0625, and 468.4625 MHz.

Sea World has communications on many channels, including 151.775, 151.805, 461.10, 461.675, 461.775, 461.85, 462.00, 463.325, 463.5625, 463.675, 463.825, 463.9125, 463.95, 464.0375, 464.0875, 464.10, 464.2125, 464.2875, 464.3375, 464.3875, and 464.4375 MHz.

At Cypress Gardens, monitor 464.375 and 464.875 MHz.

Busch Gardens uses 154.54, 154.57, 461.7125, 461.775, 462.0875, and 464.30 MHz.

Placing a scanner into search mode will surely root out many additional channels at each of those facilities, and should also produce frequencies used at attractions not listed here.

That should be enough frequencies to keep any dedicated scanner owner sufficiently dazzled to the point where the rides, parades, attractions, shops, crowds, and everything else blur into one large, annoying distraction.

RadioShack's PRO-2039 is a good choice for those who don't need cost-adding, advanced-operating features.

READERS WRITE

We received a postcard from Vince in Atlanta, Georgia, mentioning that as hurricanes threaten, there are National Weather Service-related communications noted on 165.995 MHz. That would be a worthwhile frequency to check out in other areas of the nation as well, insofar as it relates to that agency's communications during extreme weather conditions. Let us know if you pick up any activity.

Universal Studios Florida is a beehive of UHF communications.

Jess, in Broome County, New York, reports that when he got a speeding ticket, he also got a summons for having a mobile scanner. The cop told him that the mobile scanner was against the law. He wonders what that's all about, as he has had a mobile scanner for years and never before had a problem.

In New York, and in a number of other states, it is a violation of the vehicle and traffic laws to equip vehicles with receivers that can tune police frequencies. Licensed amateur-radio operators, reporters, and off-duty police officers are possible exceptions to such restrictions in specific states. It might be possible for others to secure special permits from the police to allow scanner installations.

Those laws seem to have originally been efforts to stop tow trucks, lawyers, and private ambulances from showing up at accident scenes. Certainly, hobbyists with mobile scanners would qualify for a summons where there is a law on the books banning them. A police friend advises (confidentially) that the extent to which that type of traffic law is enforced depends on the individual situation and the officer involved more than any other factor.

If there's a handheld in the car does that mean that the vehicle is "equipped" with a receiver? Is a scanner in violation of mobile laws even if it isn't programmed with police channels, or if all programmed police channels are locked out? For those who choose to have scanners in vehicles where such laws exist, opinions about these gray-area questions can be supplied only by the police officer who questions your use of a scanner.

Before using any type of scanner in a vehicle, it would be wise to find out if there are any laws regulating or restricting such use. Then, be guided accordingly.

KEEP IN TOUCH

That's all for this month. Please feel free to pass along news of frequencies to share with other hobbyists, or ask any scanner-related questions. We would like to hear your suggestions and opinions, too. Your continuing participation is appreciated and keeps us tops! Write to *Scanner Scene*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

CIRCUIT CIRCUS

(continued from page 58)

you wish, the three remaining buffers can be used for additional timing stages and cascaded with the three shown. Yes, you can add as many 4050 chips and as many cascaded stages that room allows. If you do not modify the circuit, and only use the three sections of the 4050 as shown, tie all of the other inputs to circuit ground.

Well, the clock on the wall says we're out of time for this visit. See you here next month. ■

PARTS LIST FOR THE EXPANDED TIMER (Fig. 5)

SEMICONDUCTORS
IC1—4050 hex buffer, integrated circuit
D1-D3—1N914 silicon diode
LED1-LED3—Light-emitting diode, any color

RESISTORS
(All fixed resistors are 1/4-watt, 5% units.)
R1, R2, R3—See text
R4—4700-ohm
R5-R7—2200-ohm

ADDITIONAL PARTS AND MATERIALS
C1-C3—See text
S1—SPST switch
Power source, wire, solder, etc.

DX LISTENING

Exploring the Information Highway

BY DON JENSEN

More and more SWLs are exploring the Information Highway. If you haven't yet found the on-ramp, maybe now is the time. For shortwave listeners, there's a world of information on-line.

You can find the latest station schedules. There are reviews and equipment news, as well as individual and dealer advertisements for new and used receivers and accessories. Send your reception reports directly to the stations' e-mail addresses. Or just share your views and listening tips with other world-band radio enthusiasts.

You can, of course, use your usual search engines to lead you to shortwave related newsgroups and web sites. Or you can, as I often do, take a shortcut directly to *Pete Costello's Radio Catalog* (http://itre.ncsu.edu/radio/) which has user friendly links to just about any SW source you could want or need.

Says Costello: "These pages are an expanding set of World Wide Web links to documents, web servers, ftp and gopher sites, telnet services, audio files, pictures, graphics, schedules, software and interactive on-line programs.

"The catalog of hypermedia links is split into a set of web pages covering Radio Services; Shortwave Radio Topics, including Medium Wave and FM broadcasting; and Satellite Radio."

Veteran DXer Jerry Berg, Lexington, MA, who first introduced me to what he calls The Mother of all Radio Sites, says, "It is well organized, but it would take you a very long time to actually follow all the links in this thing!"

A little poking around revealed that to be no exaggeration. There's no practical way to introduce you to more than a fraction of what is there. Here are a few links through the Radio Catalog:

What time zone is it in... You can get local date and time for any time zone, UTC/GMT, or the time of day in many other world locations.

What's on shortwave right now... Paul Dwerryhouse of Melbourne, Australia, has linked his shortwave broadcast database to generate a listing of what is on shortwave from his vantage point. An excellent reference.

You can control and listen to a top-of-the-line Drake R8 receiver live over the Internet. From Reston, VA, Jeff Chilton provides a unique service to the SWL community. You can enter the frequency, mode and other SW radio settings, then listen to what his receiver is picking up.

Need help in identifying what lingo you're hearing on SW? Then try *Simon Colling's Foreign Language Recognition* page.

For 36 years, *Radio Nederland* has been offering free pamphlets and data sheets to help listeners get started in the hobby. Now many of these free publications are available on-line. You can link to it through the Radio Catalog, or go directly to Radio Nederland's web site (http://www.rnw.nl/).

Here are some other international broadcaster web sites:

British Broadcasting Corp. World Service
(http://www.bbcnc.org.uk/worldservice/)

Voice of America
(gopher://gopher.voa.gov/)

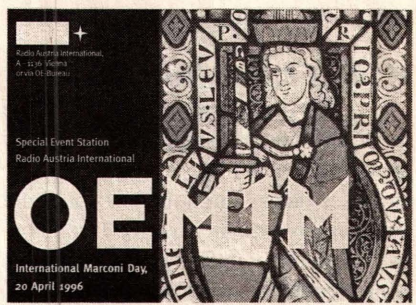
Radio Sweden
(http://www.sr.se/rs/)

Radio Australia
(http://www.abc.net.au/ra/)

Radio Japan
(http://www.nhk.or.jp/rjnet/)

Want a complete listing of U.S. and Canadian medium wave stations? You can download Werner Funkenhauser's AM Station Databases, all in .ZIP format.

You can link up with shortwave listening clubs worldwide; among them the North American SW Association, Danish Shortwave Clubs International, Benelux DX Hotline, Finnish DX Association and the Canadian French language Club d'Ondes Courtes du Quebec.



Radio Austria International issued this special QSL card to those SWLs who tuned its Marconi Day broadcast last April.

Available too through Costello's Radio Catalog are Chase Cotton's monthly shortwave program schedules for a number of the major international broadcasters, and Dwerryhouse's time-sorted list of English language programs. Manuel Rodriguez Lanza offers information on tuning the Latin American stations on the tropical shortwave bands.

MORE NET NOTES

Ralph Brandi, who maintains the North American SW Association's own web site(http://www.mcs.com/~ralph/html/naswa/) suggested more sources for the shortwave listener in a recent issue of that club's print Journal and at an SWL Fest gathering at Kulpsville, PA:

Along with Costello's Radio Catalog, says Brandi, Thorsten Koch's Internet Guide to Broadcasters (http://www.informatik.unioldenberg.de/~thkoch/)
is one of the first places to look.

Newsgroups? Try rec.radio.short-

CREDITS — Jerry Berg, MA; Ralph Brandi, NJ; Jim Clar, NY; Bob Fraser, MA; Marv Kaminsky, NJ; Richard Lemke, ALTA, Canada; Mark Mohrmann, NJ; Ed Newbury, NE; Denis Pasquale, PA; North American SW Association, 45 Wildflower Road, Levittown PA 19057.

wave and rec.radio.info.

Mailing Lists? To get on board SWL-L, send the message "HELP" to listserv@cuvmb.cc.cuny.edu.

To subscribe to Hard-Core DX, send the message *(subscribe hard-core-dx)* in the body of an e-mail letter to majordomo@lists.kotanet.fi.

An excellent site for information from the Danish Shortwave Clubs International and the Swedish Shortwave Bulletin, plus other SW articles of interest is the Nordic Shortwave Center (http://sunweb.sds.se/org/swl/).

Medium wave enthusiasts should check out the National Radio Club page (http://alpha.wcoil.com/~gnbc/) and the Medium Wave Circle (http://www.cs.vu.nl/~gerben/mwc/).

HONORING MARCONI

In 1931, Guglielmo Marconi, the pioneer of wireless telegraphy, put the Vatican's first station on shortwave. To provide better reception throughout Europe, an experimental SW transmitter in Vienna, Austria, rebroadcast the Vatican's initial program.

That was the first shortwave relay broadcast in the history of radio. Today, such relay transmissions are commonplace.

Each year, both shortwave broadcast and amateur radio stations commemorate International Marconi Day. On April 20 this year, Radio Austria International and OEM1M, the special event ham radio station it sponsored, joined forces to honor the inventor.

Ham stations around the world were invited to register in advance for contacts with OEM1M. From this registration list, Radio Austria International's weekend DX program, "Shortwave Panorama" selected several ham stations and invited them to check in with OEM1M on a certain frequency. These QSO conversations were relayed by RAI to its shortwave audience worldwide.

The hams and SWLs tuned in to "Shortwave Panorama" that day were eligible to receive a special RAII/OEM1M QSL. That verification card is illustrated in this month's column.

If you want to tune in RAI's weekly DX program, at this writing it is aired to North America on Saturdays on 13,730 kHz at 1205 UTC, and on 9,655 kHz at 0005 UTC Sundays. (Remember that because Coordinated Universal Time or UTC is five hours ahead of Eastern Standard Time, the latter transmission is actually heard on Saturday evening in the U.S. and Canada.)

To keep current on RAI's broadcast hours and frequencies, you can write for a current schedule. The address is Radio Austria International, A-1136 Wien (Vienna), Austria. Or check its web site (http://www.ping.at /rai/).

DOWN THE DIAL

Here are some shortwave stations to tune for:

ALGERIA — 15,205 kHz, Radio Algiers International has English programs from 1800 UTC. It is heard with a newscast followed by U.S., European and African music.

ANGOLA — 9,535 kHz, Radio Nacional in Luanda is heard at 2000 UTC with a combination of English and Portuguese programming and music.

BRAZIL — 15,265 kHz, RadioBras has English programming at 1800 UTC. Listen for program host Alan Bennet with a mix of Brazilian songs and classical music.

HAWAII — 13,625 kHz, World Harvest Radio's SW outlet at Naaishu, Hawaii, KWHR is noted with religious programs and music from 1900 UTC.

ICELAND — 11,402 kHz, Iceland's NBS, broadcasting from the capital, Reykjavik, was heard from 1451 to 1455 UTC signoff. Programming was in the Icelandic language but mention of "Reykjavik" was noted.

NEW ZEALAND — 11,900 kHz, Radio New Zealand International can be found here about 1400 UTC with a program of musical oldies, station identification and news.

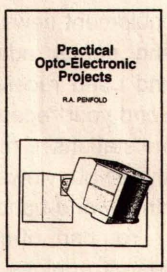
NORWAY — 11,840 kHz, Radio Denmark is relayed on shortwave by Norwegian transmitters. This was heard at 1440 UTC with an English program called "Copenhagen: European City of Culture."

UKRAINE — 6,010 kHz, Radio Ukraine International operates on this frequency, in parallel with 6,130 kHz, at 2200 UTC. It was heard in English with an interview with the chief of the Ukrainian Writers' Union. ■

You can Build Gadgets!
Here are 3 reasons why!

☐ **BP345—GETTING STARTED IN PRACTICAL ELECTRONICS $5.95**

If you are looking into launching an exciting hobby activity, this text provides minimum essentials for the builder and 30 easy-to-build fun projects every experimenter should toy with. Printed-circuit board designs are included to give your project a professional appearance.



☐ **BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS $5.95**

If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters—all are easy to build.

☐ **BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS $5.95**

The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build and all use standard, readily-available components that you can buy. The project categories are guitar, general music and MIDI.

Mail to:

Electronic Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240

Shipping Charges in USA & Canada

$0.01 to $5.00	$2.00	$30.01 to $40.00	$6.00
$5.01 to $10.00	$3.00	$40.01 to $50.00	$7.00
$10.01 to $20.00	$4.00	$50.01 and above	$8.50
$20.01 to $30.00	$5.00		

Sorry, no orders accepted outside of USA and Canada. All payments must be in U.S. funds only.

☐ Number of books ordered.

Total price of books..... $ _____
Shipping (see chart) ..... $ _____
Subtotal ..... $ _____
Sales Tax (NYS only)..... $ _____
Total enclosed ..... $ _____

Name _____

Address _____

City _____ State ____ ZIP _____

Please allow 6-8 weeks for delivery.

Antenna Topics

BY JOSEPH J. CARR, K4IPV

Antennas are always a popular topic because they are so important to successful radio operations. After all, even the best and highest-priced transmitter will not perform well without a good antenna. This month we'll look at a variety of antenna topics and move on to one exotic antenna—the Sterba curtain—that is great for the upper HF (say, above 10 MHz) or lower VHF regions, and easy to build. Above about 2-meters, other factors begin to become important and this kind of antenna loses its effectiveness.

ANTENNA GAIN

Antennas have a magical property called "gain." The gain of an antenna increases the apparent power level of the signal, during both reception and transmission. An antenna doesn't actually manufacture more RF power (which would violate the laws of physics), but instead refocuses the available power in a particular direction. The total amount of power remains constant, but the power density in any one direction is increased by the refocusing. That is also related to directivity, which is a measure of the refocusing.

There are two methods for specifying gain of an antenna. The first (and the one used most often by professional antenna engineers) is the isotropic gain. The second is the gain relative to a half-wavelength dipole.

Isotropic gain is a theoretical construction that treats the antenna as a radiating perfect sphere, and at some distance from the center of this infinitesimal sphere measures the power density. The total available RF power is distributed over the entire surface of the sphere, while the power density is measured in a small area (*i.e.* watts per centimeter squared).

Both types of gain are measured in decibels (dB), and are referred to as *dBi* for isotropic gain and *dBd* for gain over a dipole. Whenever the gain specification is not delineated dBi or dBd (*i.e.* when it is listed simply as dB), assume that dBi is meant. The difference is that dBd gain is 2.14 dB higher than dBi gain. For example, a beam antenna listed as having a gain of 6.94 dBi also has a gain of 4.8 dBd.

Antenna gain and directivity must also take other factors into account. Most people seem to think in terms of the polar or *azimuthal* pattern. That is the directional pattern as seen from above. But antennas radiate in three-dimensional space, so there is also an elevation aspect to the pattern.

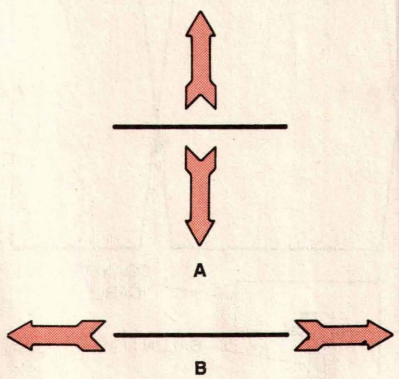


Fig. 1. A broadside array (A) sends its signal out on a line perpendicular to either the antenna element or the line of centers between the elements. An end-fire array sends its signal off the ends of the antenna element or array of elements (B).

It is common to take two slices, one elevation (vertical) and one azimuthal (horizontal), and use them to represent the entire antenna. The figure-eight dipole pattern is an example of an azimuthal pattern. The angle of radiation of the antenna is the angle of the main lobe in the elevation aspect of the radiation pattern (for long DX a low angle of radiation is desirable).

As long as those slices are truly representative, all is well. But professional antenna engineers usually take a number of envelope slices all around the compass and several azimuthal slices to totally characterize the antenna. For most of our purposes, however, a single pair of slices, one each from the vertical and horizontal aspects, is enough.

COAXIAL CHOKE

As with most antennas, the radiation pattern can be improved by reducing radiation and re-radiation from the feedline. To do that, make a 3- to 5-turn, 6- to 10-inch coil out of the coaxial cable, right at the connection to the balun transformer. This neat little coil can be taped or otherwise fastened to the balun or the center insulator, and should be used on most center-fed antennas.

END-FIRE VS. BROADSIDE ANTENNAS

Most gain antennas can be classified as either end-fire or broadside arrays. The difference is shown in Fig. 1. A broadside array (Fig. 1A) sends its signal out on a line perpendicular to either the antenna element (as in a half-wavelength horizontal dipole) or the line of centers between the elements (as in a pair of in-phase verticals, a half-wavelength apart).

An end-fire array, such as the W8JK antenna, sends its signal off the ends of the antenna element or array of elements (Fig. 1B). Some odd antennas are both end-fire and broadside, depending on the band they operate on (*i.e.* a single antenna operating on harmonically related bands).

VSWR AND IMPEDANCE MATCHING

One error that seems to be constant is that finding the lowest voltage standing-wave ratio (VSWR) means that the antenna is matched. The resonant point is indicated by the minimum point on the VSWR curve. But there is another issue. Before the antenna can be impedance matched to the coaxial cable (or other transmis-

sion line) it must first have a feedpoint resistance that is equal to the transmission-line impedance. For example, our standard half-wavelength dipole has a feedpoint impedance of 73 ohms, so we feed it with 75-ohm coax and expect a VSWR of 75/73, or 1.03:1.

In reality, the feedpoint resistance of the dipole can be anything from a few ohms to 120 ohms, depending on its height above ground. If the actual impedance is 25 ohms, then the VSWR will be 75/25, or 3:1. However, a 3:1 VSWR will trip the automatic load control (ALC) of your transmitter so hard that a 100-watt transmitter will put out a mere 1 milliwatt!

If impedance matching and minimal VSWR is your goal, then the only—repeat only—suitable place for the antenna-tuning unit is between the far end of the transmission line and the feedpoint of the antenna. Impedance matching at the transmitter end of the transmission line does wonders for making the transmitter ALC think it's seeing a matched antenna, but the antenna is performing just as badly. ATUs used in that manner are called "line flatteners" and only fool the system into thinking it's working properly.

Another old saw that needs to be addressed is the matter of transmission-line length and VSWR. Many people attempt to reduce VSWR by changing line length. It doesn't work! I don't care what your meter makes you think is happening. In fact, professional radio technicians tell whether they are measuring true VSWR or merely getting a measurement artifact by adding about 1/8- to 1/4-wavelength (actual length not important) of transmission line to the existing line. If the VSWR reading changes, you are not measuring the real VSWR. If the VSWR does not change (or changes only a little to account for line losses), you are measuring the real VSWR.

The trick to making the antenna as perfect as any practical antenna can be is to match the impedance at the antenna end of the feedline. Length is irrelevant.

Well, the length is irrelevant unless you want to accurately measure the feedpoint impedance without climbing up on the antenna and teetering precariously on a ladder (and adversely affecting the measurement!). The impedance on the end of a transmission line (e.g. the antenna feedpoint impedance) repeats every half wavelength. So if the antenna-line length is an integer multiple of the half-wavelength, then the measurement can be made at the transmitter end.

The correct physical length to make an electrical half-wavelength is the half-wavelength multiplied by the velocity factor of the line, or

$$L = 492V/f\text{MHz}$$

where L is the length in feet, V is 0.66 for polyethylene dielectric coax and 0.80 for polyfoam coax, and *f*MHz is the frequency in megahertz.

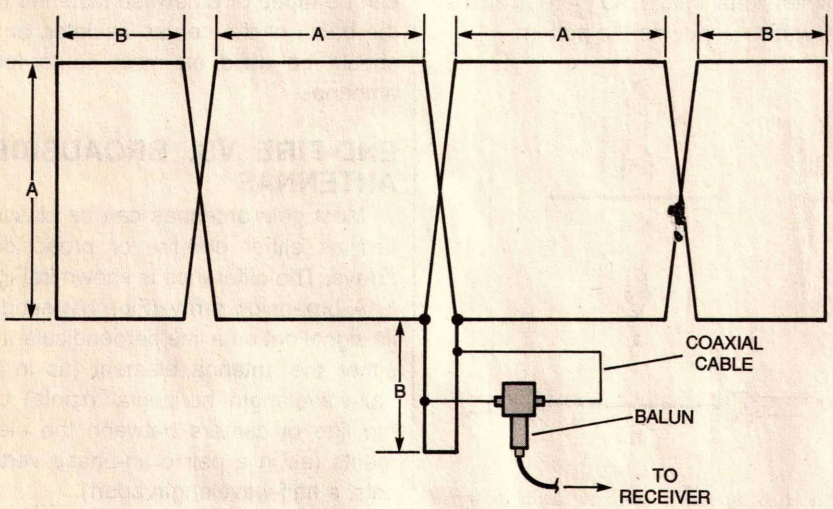


Fig. 2. A Sterba curtain array, shown here, uses only three loops, and is fed in the center by a balun and coaxial cable. Note the matching A and B lengths in the assembly.

SHORT STERBA CURTAIN

The Sterba curtain array is a well-known antenna in the shortwave-broadcasting world. It consists of a number of half-wave dipoles in an array that transmits broadside to the plane of the dipoles. Although shortwave broadcasters use huge Sterba curtain arrays, amateur-radio hams can make relatively simple Sterbas using only a few elements (as shown in Fig. 2).

The Sterba curtain array, which is one of three antennas usually called *Six-Shooters*, uses only three loops, and is fed in the center by a balun and coaxial cable. It provides about 4.8 dBi of gain and is bi-directional (the polar pattern is a figure-eight like a dipole, but more compressed). Other Sterba curtain arrays are end fed at either a corner of the squares or in the middle of the side of an end-square. Those arrangements are often fed with 600-ohm parallel open feeders. If the feeders are tuned, rather than matched, then the antenna will work on harmonically related bands, especially those of higher frequency than the band it is cut for.

KEEP IN TOUCH

That's all for this month. I can be reached three ways. Write to me care of the editors, or direct at P.O. Box 1099, Falls Church, VA 22041. Or, send me an e-mail at carrjj@aol.com. I tend to answer the e-mail when I get them, but it may take a few weeks to answer snail mail. ■

"Why don't you just blow one more fuse and come to bed?"

What's better than speed reading?
Speed Learning.

Speed Learning has replaced speed reading. It's a whole new way to read and learn. It's easy to learn...lasts a lifetime... applies to everything you read. It may be the most productive course you've ever taken.

Do you have too much to read and too little time to read it? Do you mentally pronounce each word as you read? Do you frequently have to go back and reread words, or whole paragraphs, you just finished reading? Do you have trouble concentrating? Do you quickly forget most of what you read?

If you answer "Yes" to any of these questions — then here at last is the practical help you've been waiting for. Whether you read for business or pleasure, school or college, you will build exceptional skills from this major breakthrough in effective reading, created by Dr. Russell Stauffer at the University of Delaware.

Not just "speed reading" — but speed reading — thinking — understanding — remembering — and — learning

The new *Speed Learning Program* shows you, step-by-proven step, how to increase your reading skill and speed, so you understand more, remember more and use more of everything you read. The typical remark from over one million people taking the Speed Learning program is, "Why didn't someone teach me this a long time ago." They were no longer held back by their lack of skills and poor reading habits. They could read almost as fast as they could think.

What makes Speed Learning so successful?

The new *Speed Learning Program* does not offer you a rehash of the usual eye-exercises, timing devices, and costly gadgets you've probably heard about in connection with speed reading courses, or even tried and found ineffective.

In just a few spare minutes a day of easy reading and exciting listening, you discover an entirely new way to read and think — a radical departure from anything you have ever seen or heard about. Speed Learning is the largest selling self-study reading program in the world. Successful with Fortune 500 corporations, colleges, government agencies and accredited by 18 professional societies. Research shows that reading is 95% *thinking* and only 5% eye movement. Yet most of today's speed reading programs spend their time teaching you rapid eye movement (5% of the problem), and ignore the most important part, (95%) *thinking.* In brief, *Speed Learning gives you what speed reading can't.*

Imagine the new freedom you'll have when you learn how to dash through all types of reading material at least twice as fast as you do now, and with greater comprehension. Think of being able to get on top of the avalanche of newspapers, magazines and correspondence you have to read...finishing a stimulating book and retaining facts and details more clearly, and with greater accuracy, than ever before.

SPEED LEARNING
SPEED LEARNING
Goes Beyond Speed Reading To Develop Advanced Learning Skills
High Efficiency Reading BOOK 2
HEMINGWAY
THE OLD MAN AND THE SEA

FOR FASTER SHIPMENT CALL 1-800-729-7323 OR FAX 1-609-273-7766

Listen — and learn — at your own pace

This is a practical, easy-to-learn program that will work for you — no matter how slow a reader you think you are now. The *Speed Learning Program* is scientifically planned to get you started quickly...to help you in spare minutes a day. It brings you a "teacher-on-cassettes" who guides you, instructs, and encourages, explaining material as you read. Interesting items taken from *Time* Magazine, *Business Week, Wall Street Journal, Money, Reader's Digest, N.Y. Times* and many others, make the program stimulating, easy and fun...and so much more effective.

Executives, students, professional people, men and women in all walks of life from 15 to 70 have benefitted from this program. Speed Learning is a fully accredited course...costing only 1/4 the price of less effective speed reading classroom courses. Now you can examine the same easy, practical and proven methods at home...in your spare time...without risking a penny.

Examine Speed Learning RISK FREE for 15 days

You will be thrilled at how quickly this program will begin to develop new thinking and reading skills. After listening to just one cassette and reading the preface, you will quickly see how you can achieve increases in both the speed at which you read, and in the amount you understand and remember.

You must be delighted with what you see, or you pay nothing. Examine this remarkable program for 15 days. If, at the end of that time you are not convinced that you would like to master Speed Learning, simply return the program for a prompt refund. (See the coupon for low price and convenient credit terms.)

RISK-FREE ORDER FORM

☐ **YES!** I want to try Speed Learning for 15 days without risk. Enclosed is the first of 4 monthly payments of $32.25*. If I'm not completely satisfied, I may return it for a prompt refund.

☐ **SAVE 8.00!** I prefer to pay the $129.00 now, and save the $8.00 shipping & handling charge. I may still return the program for a full refund.

Method of payment: (Federal Tax Deductible)
☐ Check or money order payable to Learn Incorporated

☐ Charge to: ☐ Visa ☐ MC ☐ Am Ex ☐ Discover

Card # _____ Exp. _____

Signature _____

Phone (_____) _____

Name _____

Address _____

City _____ State ____ Zip _____

*Plus $8.00 shipping and handling. U.S. funds only. For New Jersey residents, sales tax will be added.

learn INCORPORATED Dept. LPE-01, 113 Gaither Drive, Mt. Laurel, NJ 08054-9987

Think Tank

Looking Back

BY JOHN YACONO
TECHNICAL EDITOR
WINDOWS MAGAZINE

This month, we've got some letters that provide or request help on circuits from past issues. We'll get to them after I present some more facts on our current topic: electromagnetism.

As I pointed out last month, current flowing through a wire generates a magnetic field. To help visualize a field, we normally draw lines with arrow heads around the object that generates it. For example, to indicate the electric field generated by a charged particle or object, we draw arrows coming out of the object if it's positive (see Fig. 1A), or into it if it's negative (see Fig. 1B). The arrows represent the direction a positive particle would tend to travel under the influence of the electric field. Another way to say it is the arrows point in the direction the force of attraction or repulsion would drive a positive particle, so the lines are sometimes called "electric lines of force." Also, the closer adjacent lines are, the stronger the electric field.

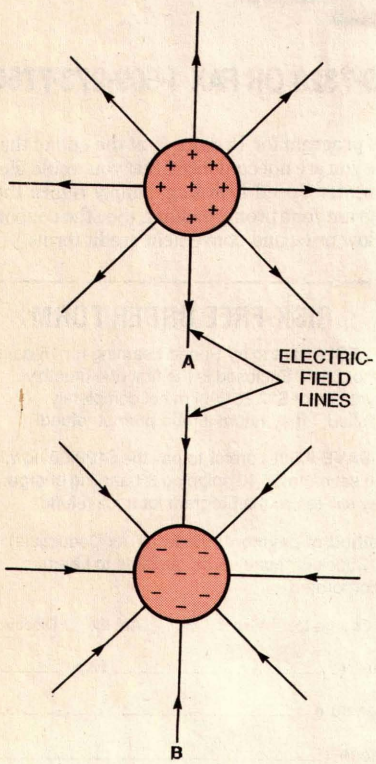


Fig. 1. To indicate the electric field generated by a charged particle or object, arrows are shown coming out of the object if it's positive (A), or into it if it's negative (B).

Magnetic-field lines are drawn quite differently. They are drawn perpendicular to the force of attraction or repulsion. They are also perpendicular to the current flow that generates them. However, just like lines of electric force, the more dense the lines, the stronger the magnetic field. Figure 2 illustrates the concept. There, the electrons flow in a straight line, producing a cylindrical magnetic field around the wire.

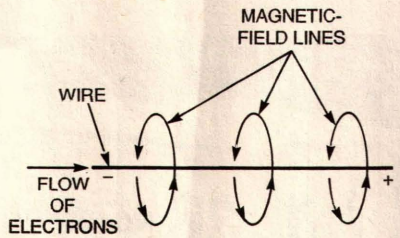


Fig. 2. Magnetic-field lines are perpendicular to the current flow that generates them.

Now, imagine slowly bending the wire from a straight line to form a loop or circle. What would the magnetic-field lines look like? They'd look something like those in Fig. 3. Note how the magnetic-field lines harmoniously converge at the center—they all point in the same direction. That means we can continue adding turns to this primitive component; each turn will increase its magnetic field strength. This assembly is called a coil or inductor, and it exhibits a field like that illustrated in Fig. 4A. The simple coil is called an "air-filled inductor" because there's only air in the center or core.

As with capacitors, the space within a coil can be filled with various substances—called "core" materials or "coil forms"—to enhance the properties of the inductor (see Fig. 4B). Core materials concentrate the magnetic field lines, allowing designers to build what would otherwise be a large inductor in a small space.

Another trick is to wind a coil in multiple layers. In other words, once you've wound enough turns of wire to completely cover a form, you can continue adding more turns on top of the windings touching the form. That might not seem right because the second set of turns winds its way back toward the beginning of the first set of windings, but what's important is that the windings share the same rotation (clockwise or counter-clockwise) around the form, not the direction in moving from end-to-end on the form.

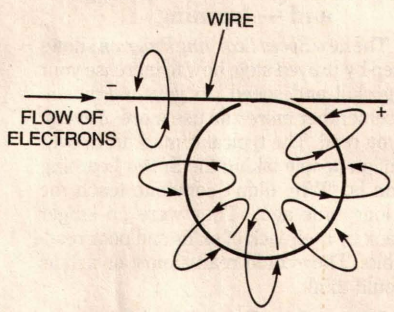


Fig. 3. In a loop of wire with current flowing through it, magnetic-field lines converge at the center and all point in the same direction.

You can prove all these things to yourself by wrapping 100 or so sloppy turns of insulated wire around an iron nail of some sort. Connect the ends of the wire to three or four D cells connected in series. The coil then attracts bits of iron (like filings or metal paper clips) just like a plain magnet. Note how the iron nail seems to be the most magnetic part of the assembly. If you can remove the nail, note that the coil still attracts objects, but in a less-powerful way.

That's enough to digest for now. Let's get to the letters.

ALARM MAKEOVER

Having built the alarm circuit by Gorden Reeder featured in *Think Tank*, April 1991, I have experienced many false alarms due mainly to re-

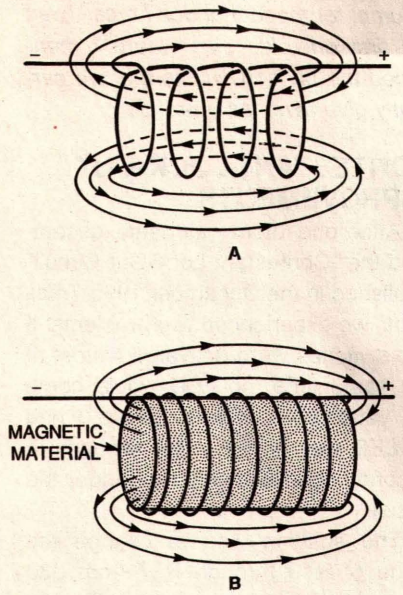


Fig. 4. Several loops or turns in a row make a coil (A); each turn increases the magnetic field strength. Another way to increase the strength of the field is to add a magnetic-material core (B).

boots after intermittent power outages and/or surges on the AC power lines. I decided to see if it would be possible to overcome the problems and add a few features.

My first priority was to use parts readily available and reasonable in cost. The parts I used are in stock at RadioShack, Hosfelt Electronics (2700 Sunset Blvd., Steubenville, OH 43952; Tel. 800-524-6464), and other suppliers.

To hold DC voltages constant I used a 12-volt-DC, 500-mA, wall transformer that floats to 17-volts DC with no load. The transformer's output is regulated by a 7812 regulator and a couple of electrolytic capacitors in my circuit (see Fig. 5). The false alarms were prevented by adding a 1000-ohm resistor (R12) in series with C2, the entry-timing capacitor.

The following are other changes and additions I made: The output from pin 4 of IC1-d was used to drive a 2N3904 transistor (Q1), which inverts the positive-going signal from the IC. The negative signal at the collector of Q1 is coupled through a 0.22-µF capacitor to the trigger (pin 2) of 555-timer IC2. The purpose of IC2 is to control the length of the relay's on-time when power is fed to the siren. With the values shown, that is adjustable (using R3) from three seconds to four minutes. For those who wish to have the siren on continuously, simply use switch S2 to short out capacitor C4. Now the siren can only be stopped by flipping S1 to the "safe" position.

Components C3 and R17 prevent IC2 from coming on during power-up; LED3 was left in to verify relay operation as I was developing the circuit. From the relay output contacts I used an SPDT switch, S3, to select between the external siren or a chassis-mounted 12-volt piezo-buzzer, BZ1, used for neighbor-friendly verification. I also included a panic switch, S12, which

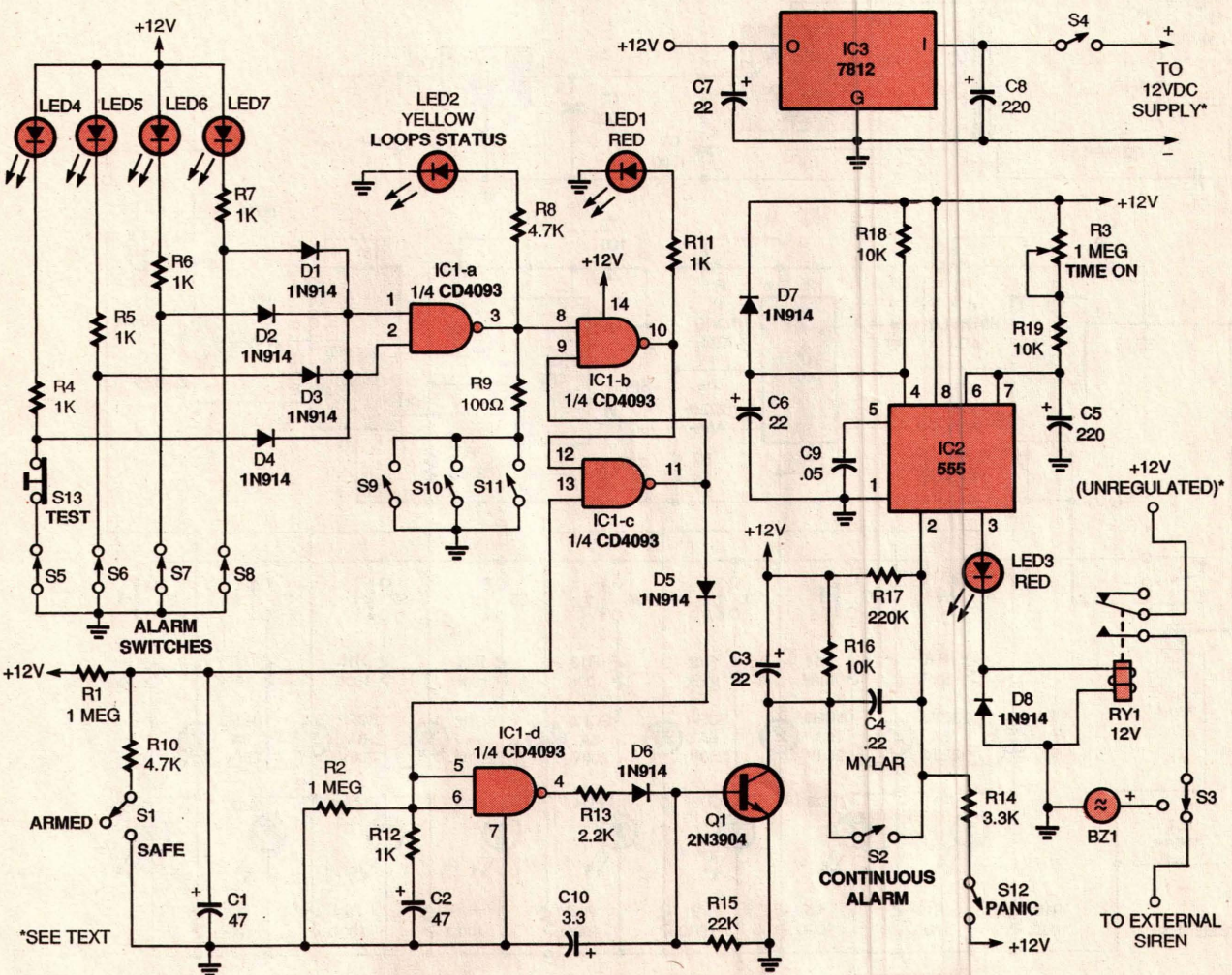


Fig. 5. This alarm circuit contains some excellent features, including a panic switch and adjustable siren.

activates IC2 when S1 is in the "safe" position. It will immediately turn the siren on.

A red, blinking LED, LED1, was added as a visual indication that the circuit needs to be reset (by switching S1 to safe). I used four, normally closed, trip switches. If you wish, you can add more. Each has a status indicator. The first normally closed loop is broken by a normally closed test switch on the chassis for testing.

Be sure to run 12 volts from the unregulated wall supply to the relay contacts that power the siren voltage. The wall transformer should be sized to handle the current demand of the siren you use.

To operate the alarm, switch S1 from "safe" to "armed" when leaving the premises. You will then have less than 30 seconds to close any alarmed doors. On entering, you will have up to 30 seconds to switch S1 to the "safe" position. When on the premises, move S1 to the "safe" position to enable the panic switch.

I built the circuit using sockets for IC1 and IC2, and mounted it on a RadioShack No. 276-168 board. Hosfelt has magnetic alarm switches (No. 51-351) and for the relay I used, a 12-volt unit with a 720-ohm coil (No. 45-346).

What I ended up with is an alarm that features readily available parts, loop-status indicators, 30-second exit and entry times, a panic switch, adjustable siren, and no false alarms on AC power interruptions.

Many thanks.

—Roger W. Hamel, Cedarville, MI

Wow, you took a simple circuit pretty far!. This column is really bringing back memories for me: The April 1991 column, for those that don't recall, was my first one. It's also where I mentioned the MCL1010 chip that we currently give away as a premium.

CONTESTANT-LOCK-OUT IMPROVEMENTS

After one of my students assembled the "Contestant Lock-Out Circuit" published in the December 1995 *Think Tank*, we experienced two problems: If two switches were activated almost at the same time, no LED would come on, yet there was sound. Also, when an LED was on for a few seconds, a second contestant could re-trigger the circuit.

The solution was to change the value of R10 through R17 from 330 ohms to 100,000 ohms (see Fig. 6). That eliminated both problems. The

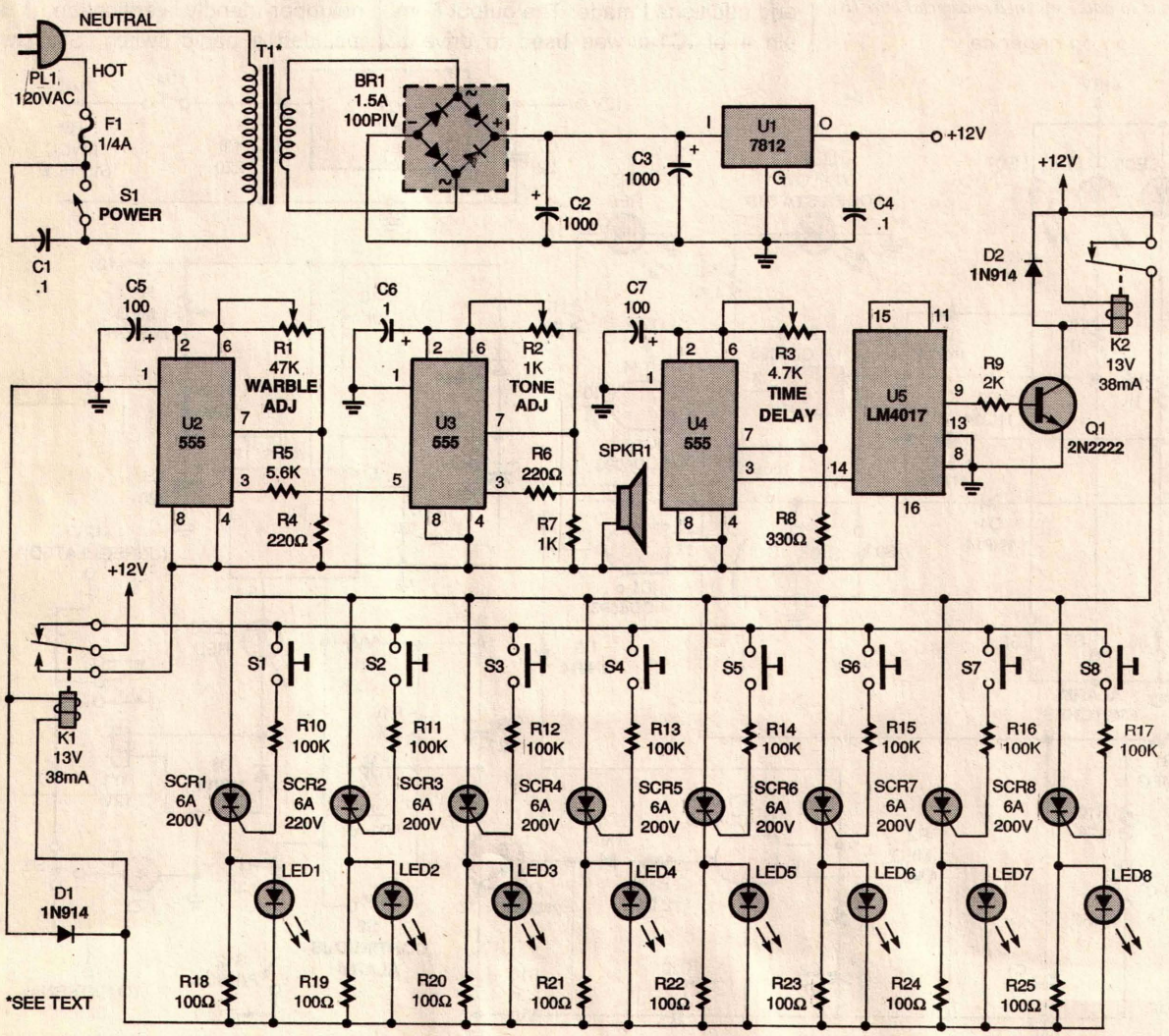


Fig. 6. Do you enjoy game shows like Jeopardy*? This improved contestant lock-out circuit indicates which of up to eight players rings in first.*

original value supplied a trigger voltage that is slightly higher than required and provided only a little isolation between the SCR circuits.

—Ron Navarro, Ontario, Canada

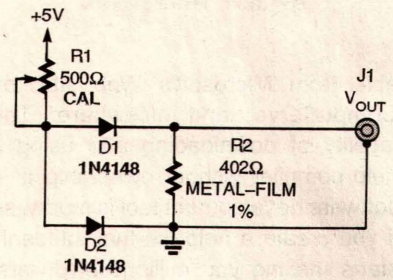


Fig. 7. This simple circuit uses two 1N4148 diodes to form a temperature-compensated millivolt reference.

Nice work and thanks for the tip. It's naturally impossible for me to build and test all the circuits I get here, and as you've shown, even something that looks good on paper can have a glitch or two. Keep in mind that T1 is a 120- to 12.6-volt, 1.2-ampere transformer. Hope your class enjoys the circuit.

MARCH AND JUNE CIRCUIT UPDATES

I just received my June 1996 issue of **Popular Electronics** and once again, I must thank you and the staff of the magazine for the excellent presentation of my work in *Think Tank*. I appreciate that there were no errors, and the kit and other goodies, also!

Here's another note on my "Simple Reference" featured there. By selecting two 1N4148 silicon diodes with, say, a 10-millivolt difference in forward voltage, and using them in place of D1 and LED1, you can make an excellent temperature-compensated millivolt reference (see Fig. 7). If the diodes are from the same lot and manufacturer, you can expect a negligible temperature coefficient.

The "L/C Oscillator" from that issue ended up driving my "THD Adapter" from your November 1994 column. By the way, I made a small glitch in the inductance equation for the oscillator circuit. Here's what it should read:

$$L = C1 \times R1 \times R2$$

Also, after submitting the circuits in the March 1996 **Popular Electronics**, I discovered that at certain low frequencies, with slow rise and fall times, IC2 (LM311) in the frequency counter (see Fig. 8) would tend to oscillate, giving an abnormally high output indication. That is easily corrected by adding a small amount of positive hysteresis to the comparator. Just connect a 2200-ohm, 1/8-watt, 5-percent resistor from pin 2 to pin 7 on IC2 (that resistor is shown as R24). As specified in my original article, Digi-Key (P.O. Box 677, Thief River Falls, MN 56701; Tel. 800-344-4539) carries a multiplexed display (#P454) that should work just fine in the circuit.

—Skip Campisi, South Bound Brook, NJ

Thanks for the updates! Skip freely offers help on his circuits; you can write directly to him at: 143 Cedar Street, So. Bound Brook, NJ 08880.

INFRARED SWITCH

I have enjoyed your column and have used some of the projects that have been in it. Now I need some help with a project that I'm building. I'm trying to activate a relay with an infrared remote, which is only a 9-volt battery, a resistor and an IR diode. I found a relay circuit that uses a 2N2222 transistor and a phototransistor, but I can only activate it from about six-inches away. I need to activate the relay from about ten-feet away, and want the relay to act like a momentary switch.

I also have an IR detector module (RadioShack no. 276-137) if needed. I hope you can help me with my problem; I always look forward to your column, it has really helped me out.

—Karl Jondahl, Glasgow, MT

To make a remote detector that operates over that kind of distance,

continued on page 71

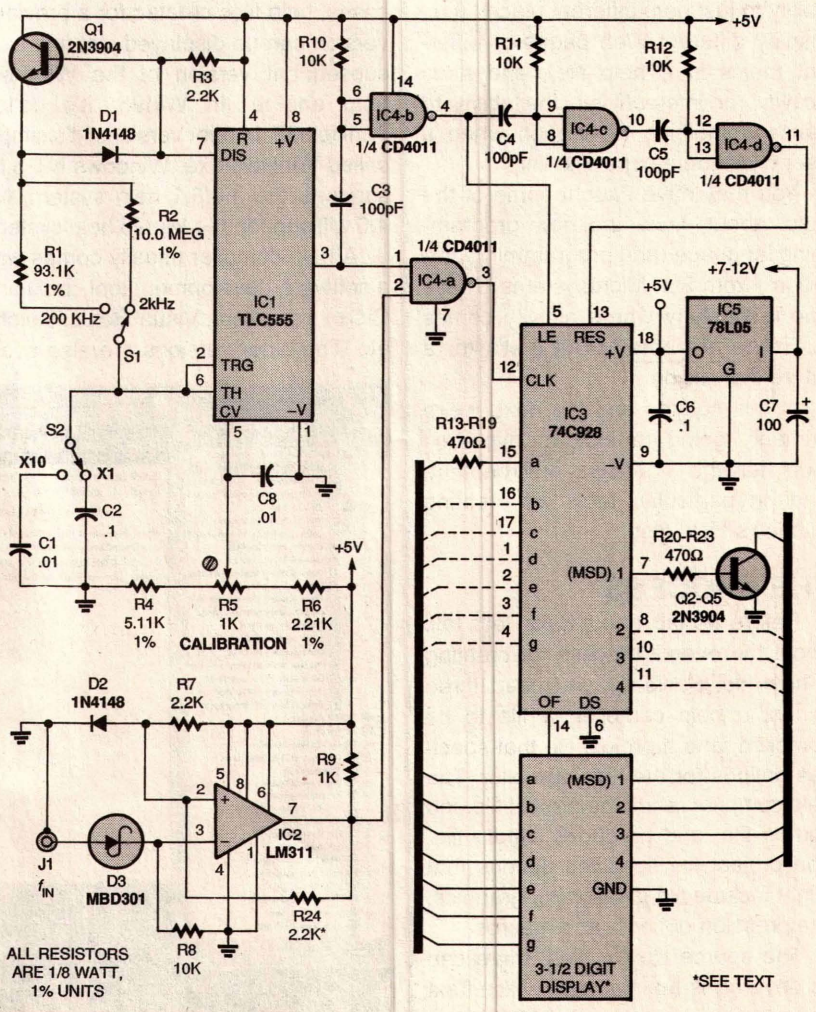


Fig. 8. While this frequency counter is very simple, it has 2000-Hz, 20.00-kHz, 200.0-kHz, and 2.000-MHz ranges, and will work with almost any waveform.

COMPUTER BITS

Help!

BY JEFF HOLTZMANN

In the previous column we started a discussion on hypertext. I'm sure that you remember that hypertext is the loose principle by which the World Wide Web operates. The concept behind hypertext is deceptively simple: Rather than depending on strict linear narrative, hypertext allows associative jumps among several topics. Click here, jump there, click here, jump there.

Before widespread availability of multimedia computers, hypertext referred strictly to text. The next evolutionary step added graphics, sound, video, and other elements—hypermedia. The third step goes beyond the ability to just *goto* different places (i.e., display different Web pages or different topics in a help file), and adds *activity (or interactivity),* the ability to cause something to happen when a user clicks on a hypertext link.

You may have caught some of the buzz about Java, the new programming language (and programming paradigm) from Sun Microsystems. That's one technology where activity comes in. There are others. But that's for a future discussion.

In this column and the next, we're primarily going to look at hypertext tools for the Windows environment. And, in particular, tools for creating Windows Help files.

THE PROCESS

Before we talk about tools, let's talk about the overall process for creating a help file. Basically, you need three things: a help compiler, a file to be compiled, and a project file that specifies options for the help compiler. The help compiler reads the project file and source file, and produces a help file. The project file specifies options that might include file location(s), graphics, compression options, and macros.

The source file (or files, there can be several) is maintained in Rich Text Format (RTF), a text-only (ASCII) format created by Microsoft that allows formatted text to be interchanged among applications and platforms. You can write RTF in a text editor, but doing so is like programming in assembly language. To move to a higher-level language, most help authors use Microsoft Word, which has a save-as RTF option. You can also create RTF with Word Perfect and other word processors, but for the best compatibility use Word.

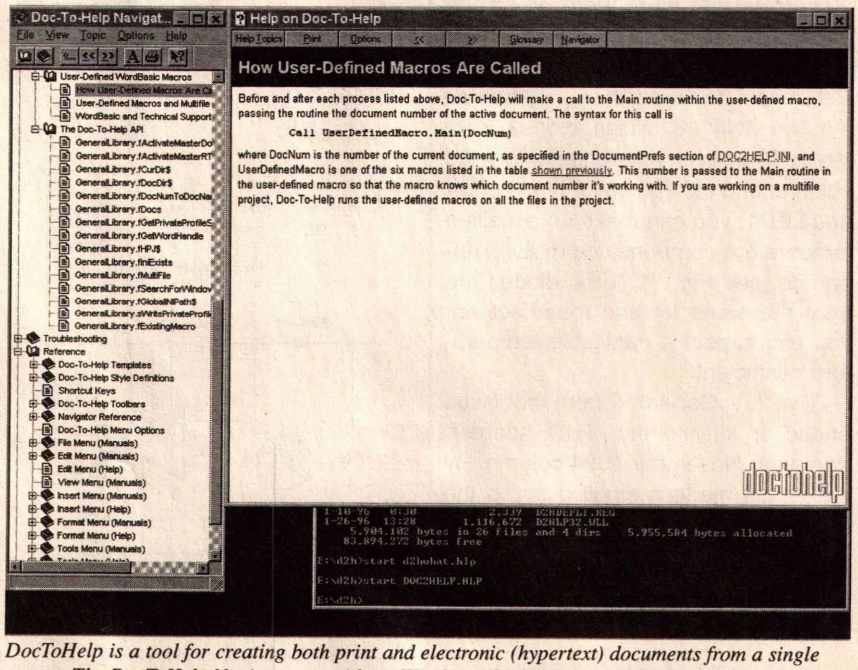
There are several help compilers, all made by Microsoft. HC30 creates Windows 3.0 help files. HC31 and HCP create Windows 3.1 files. HCRTF creates Windows 95 help files. In most cases, help files created for a previous version can be displayed just fine by a subsequent version of the Windows help engine. In Win95, it's called WinHelp32. In prior versions, it's simply called WinHelp.exe. Windows NT 3.5x supports the 3.0/3.1 help system; NT 4.0 will support the Win95 help system.

A help compiler usually comes with a software-development tool, including C/C++ compilers, Visual Basic, Delphi, etc. The older versions are also available from Microsoft's Web site, on CompuServe, and elsewhere. The legality of downloading and using a help compiler without ownership of a software development tool is murky, so if you create a help file that suddenly starts making you millions of dollars, don't be surprised if you get a call from Microsoft's lawyers. I wouldn't worry about it for personal and experimental use although such unlicensed use is not legal.

You can also obtain help compilers with the third-party help-development tools we'll be discussing next time, and in some of the books that specialize in Windows help authoring.

YOUR FIRST HELP FILE

It's traditional when learning a new programming language to first write a program that simply displays the message "Hello world!" To create your own hello-world help file, you need three things: A help compiler, a source file, and a project file. If you have no other access, search for HC*.* on CompuServe or Microsoft's Web site.


Doc-To-Help Navigat...
File View Topic Options Help
Help on Doc-To-Help
Help Topics Print Options Glossary Navigator
How User-Defined Macros Are Called
Before and after each process listed above, Doc-To-Help will make a call to the Main routine within the user-defined macro, passing the routine the document number of the active document. The syntax for this call is
Call UserDefinedMacro.Main(DocNum)
where DocNum is the number of the current document, as specified in the DocumentPrefs section of DOC2HELP.INI, and UserDefinedMacro is one of the six macros listed in the table shown previously. This number is passed to the Main routine in the user-defined macro so that the macro knows which document number it's working with. If you are working on a multifile project, Doc-To-Help runs the user-defined macros on all the files in the project.
doctohelp
E:\d2h>start d2hwhat.hlp
E:\d2h>start DOC2HELP.HLP

DocToHelp is a tool for creating both print and electronic (hypertext) documents from a single source. The DocToHelp Navigator provides a Windows 95-like tree view of document structure.

You should find a file called HC505.ZIP. That is the final version of the Windows 3.11 help compiler. Download it, unzip it, and put HCP.EXE and HC.ERR in a directory on your path. Help files created by this version will run just fine under Windows 3.1x, Windows 95, and Windows NT.

Then create a directory called TEST. In it, create two ASCII files using DOS EDIT or your favorite text editor. One is called TEST.RTF; the other is called TEST.HPJ. The contents of the two files are shown in Listing 1. Then run the help compiler on the project file by typing:

```
C:\TEST\>HCP TEST
```

If all has gone well, you'll see no error message. Then run the help file. If you're running Windows 95, you can start the program by typing:

```
C:\TEST\>start test.hlp
```

If you're running an earlier version of Windows, run WinHelp, then do a File/Open and load TEST.HLP from your test directory. However you start it, after you open TEST.HLP, you should see a single-topic help file containing the magic words.

LISTING 1—TEST.RTF

```
{\rtf\ansi
Hello World!
}
```

The RTF file we created was acceptable to the help compiler, but was lacking certain header information that should be included in a real help system. When you do a Save As from a word processor, the additional header information will be included automatically. In addition, when your RTF file contains stylized text (different fonts, spacings, etc.), you will see additional codes. Your document may also contain graphics and tables (but don't try to use table borders).

BEYOND THE BASICS

It's a big step from our Hello World file to the elaborate help systems that come with most Windows applications. The reason is that setting up and linking the overall information *structure* in WinHelp depends on the use of some really ugly formatting conventions in the RTF file. Even if you use a good Word processor, creating a clean help file is messy. You have to use unusual formatting (underlining and hidden text), along with a set of totally unintuitive footnote codes to define the jump from and jump to points.

LISTING 2—TEST.HPJ

```
[FILES]
TEST.RTF
```

Creating hotspots (as they're called) on graphics requires converting a graphic file into a proprietary format, using a special tool to draw rectangles around the hotspot areas, and then specifying the action that is to occur when the user clicks on the hotspot. There are all kinds of rules (technotrivia) about things you can and cannot do in help source files. There are few good sources of organized information, so you really have to hunt around, experiment a lot, or both, to become expert.

The help system has a macro "language" that has no data types and can return only Boolean (True/False) values on certain very limited tests. You can register and call external DLLs from a help file, and that gives you the ability to surmount some built-in limitations. For example, you can play WAV and AVI files after clicking on a WinHelp hotspot.

To help manage that complexity, a mini-industry has sprung up that offers a wide variety of shareware and off-the-shelf WinHelp development tools. Mostly they help automate the tedium of entering the hypertext coding. A few move into a higher-level plane where you can focus more on the design of the information structure, and less on the footnote codes. Butnone goes far enough.

And then there's the Web. Over time, it's going to obsolete everything about the WinHelp system. But until the Web becomes truly ubiquitous, WinHelp will continue to be a viable solution. Next time we'll examine several of the best current-generation tools: RoboHelp, Doc-To-Help, and the HyperText suite. Following that, we'll show why they're all doomed. ■

THINK TANK

(continued from page 69)

you have to make it very sensitive. That makes it susceptible to activation by other sources of IR, unless you build it to discriminate a signal issued only by a special remote. To that end, check out the "Remote-Controlled Outlet" in the November 1991 ***Popular Electronics****. In the article, Marc Spiwak and I describe how to build two remote-controlled power outlets complete with IR remotes. They are based on the IR-detector module you have.*

PARTS FOR THE MEGOHM ADAPTER

Regarding the Megohm adapter in the March 1996 issue of **Popular Electronics**, where can the teflon-insulated stand-offs and BNC units be purchased?

—Edwin C. Smith, Ocala, FL

Try Digi-Key, whose address and number were listed earlier. They've got a very thorough catalogue.

WHICH IS RIGHT?

I am going to put some more status lights on my modem. Looking through all my magazines, I came across a problem. Herb Friedman's "Breakout Box" (*Hands-On Electronics*, Summer 1984) lists line 21 as the Ring Detector, but "More On Modems" by Herb (July 1986, *Computer Digest*) lists line 22 as the Ring Detector, and "Programming Serial Ports," **Popular Electronics**, August 1993 by John Yacono also lists line 22 as the Ring Indicator. Which is right?

Also in "More On Modems," line 5 is listed as DSR and line 6 as CTS, but "Programming Serial Ports" lists 5 as CTS and 6 as DSR. Please tell me which is right so I can mark my lights.

—Joseph W Baldwin, Warren, MI

I looked the definitions up just to be sure. The ring indicator (RI) is line 22, CTS is line 5, and DSR is line 6. By the way, thanks for reminding me of Herb. He was a consummate hobbyist, friend, and mentor of mine, and thinking of him always makes me smile.

As always, send your best circuits to *Think Tank*, **Popular Electronics**, 500 Bi-County Blvd., Farmingdale, NY 11735. ■

ANTIQUE RADIO

A New Restoration

BY MARC ELLIS

It has been a while since we started a new restoration project. Up to now, I hadn't really had any ideas that captured my imagination. Although I certainly have a backlog of several sets I'd like to work with, a few of them are missing critical and hard-to-get parts; others lack documentation or a source for same. The problem was solved about a week ago when a friend came visiting.

"I have something for you," my friend said, opening his trunk. Reaching in, he pulled out a trim little shortwave receiver with a black-and-gray front panel and a blue-and-white slide-rule dial. Taking the set from him, I peered at the panel with interest. It turned out to be a Knight (Allied Radio) *Star Roamer.*

"And there are a couple more things," said Gary, opening the back door of his car. The intriguing little boxes he pulled out turned out to be a Heathkit Q-Multiplier (a device for increasing the selectivity of a receiver) and a Holstrom Associates preselector (broad-band RF amplifier), covering 3.5—30 MHz. That range includes the 80-, 75-, 40-, 20-, 15-, and 10-meter ham bands.

It had happened to be a trash pickup day in Gary's neighborhood. That morning, he'd spotted these items in a neighbor's garbage container and thought of me. *Voila*! Looking at them, I immediately envisioned a new series of *Antique Radio* columns.

STAR ROAMER BACKGROUND

I'm assuming that because they were found together, the three units were used together. Additional evidence is the RCA phono jack jury-rigged to the back of the receiver, apparently to receive the phono plug from the Q-Multiplier or preamplifier. The original owner had probably purchased the (very basic) receiver first, then added the enhancements later to improve performance. One can't help but wonder how much better off he might have been if he'd used the total sum spent on the three units to purchase a more advanced receiver in the first place!

I also spent some time wondering who the original owner was and why his little trove of equipment was in the trash. Perhaps he was a young man who left home to begin a career, eventually losing interest in his hobby and his gear. Perhaps he was a more mature person who wanted to explore short wave listening or ham radio—but either didn't take it any further or progressed to a much more sophisticated setup. Well, we'll never know.

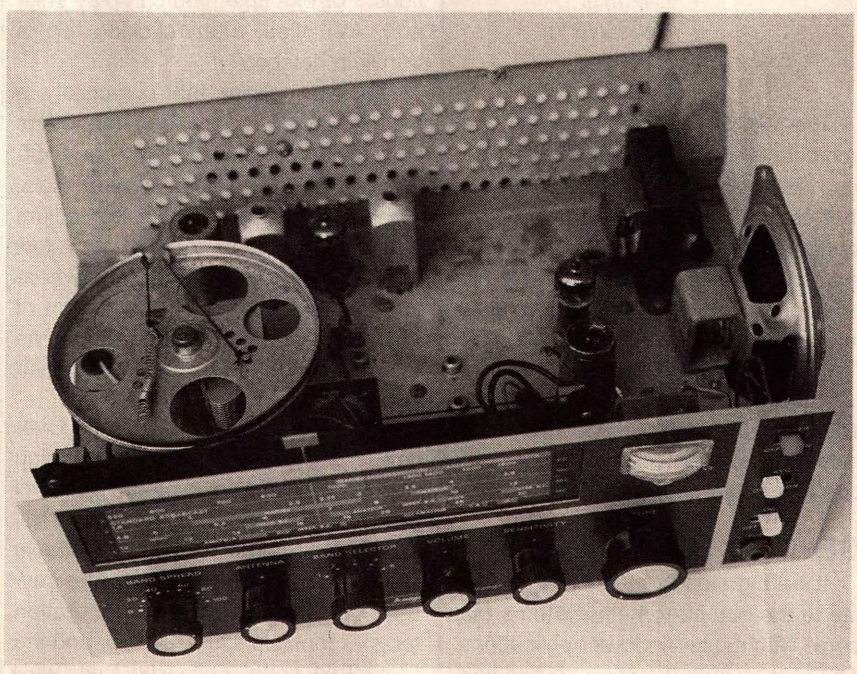
I happen to have a small collection of vintage mail-order electronics catalogs (primarily Newark, Allied, and Lafayette). Allied was the manufacturer of Knight equipment, and—taking a guess—I started to look through the catalogs from the mid-1960s. I hit paydirt in the 1966 catalog. There was a two-page spread on the Star Roamer. Priced at $39.95, it was the "top of the line" of Knight shortwave receiver kits.

As a mid-60's set, this radio will be the newest piece of equipment ever restored in the column. But at 30-some years old, it's still a very respectable antique and, let's face it, it's about time we had something for the baby boomers in the crowd!

The catalog also contained write-ups on the lesser sets in the line. While the Star Roamer was a superhet, the Ocean Hopper ($15.95), Space Spanner ($18.95), and Span Master ($24.95) were regenerative models. Those are all names that I see often in classified "want lists." Although they are minimal radios, they seemed to have captured the buying public's imagination when new, and are sought after by collectors now. The Ocean Hopper was perhaps most like a classic 1920's shortwave set, with its plug-in coils, plain styling, and pointer knobs.

INSPECTION

Realizing that the Star Roamer was a kit radio, the first thing I did was to pop the covers and take a look at the



Here's the Star Roamer as found, with its cabinet removed for inspection.

wiring. It had obviously been done with skill and care. The wiring of the Q-Multiplier had also been done by the same careful hand. Later, when I get my hands on the documentation for these units, I'll check the connections against the schematic on a component-by-component basis.

And speaking of documentation, I was pleased to discover that the manuals for both the Knight and Heath units are available from my usual source: Hi Manuals, P.O. Box 802, Council Bluffs, IA 51502. They are a little more expensive than I would like but I suppose that's because both units were kits and the manuals not only have construction information, but also more alignment and adjustment information than usual. I hope to have both of those manuals on hand by the time I'm ready to put together next month's column.

To do business with Hi-Manuals, by the way, one must first order their current catalog (which happens to be catalogue "M," price $2.00 U.S.; $3.00 elsewhere). The catalog contains complete availability and ordering information.

Cosmetically, the receiver, Q-Multiplier, and preamp are in pretty good shape. I put aside the latter two units for detailed inspection later and concentrated on the Star Roamer itself. The gray enamel on its case is in pretty nice shape, showing only some grime and faint traces of corrosion. It should clean up nicely.

The composition-board back panel is cracked along a line of ventilating holes, but it looks as if the repair will be almost invisible from the outside. A loopstick antenna, which does *not* look original, is mounted on the rear of the panel. There is also a set of screw terminals for an external antenna and ground.

The front panel and chassis underside look almost mint. The rear apron of the chassis has a fine coating of rust, but it's not too bad. The plating on the upper deck has started to develop those unpleasant dark blotches of corrosion, but will certainly look a lot better after a light polishing.

Under the grime, I noted that the original owner had scribed his name and the date he completed the kit (January 1, 1965). I won't give the full name. But Ken, if you see this and recognize the set, you know who you are! And if you received the radio as a Christmas present, you obviously lost no time putting it together!

This ad for the Star Roamer appeared in a mid-1960's Allied catalog. The attractively designed set offered lots of value for the money.

TUBES AND CONTROLS

The Star Roamer has a four-tubes-plus-rectifier circuit. The rectifier is a half-wave selenium stack and the tubes are mostly seven-pin miniatures: 6BE6 pentagrid converter; 6HR6 IF amplifier; 12AX7 (the lone 9-pin miniature) detector/first audio; 6AK6 audio output.

The front-panel controls include bandspread, antenna trimmer, bandswitch, volume, sensitivity, and the flywheel-weighted tuning control. There are also slide switches for power, noise limiter, and AVC, as well as a phone jack and "s"-meter. The bands marked on the slide-rule dial are 200–400 kHz (marine/aircraft beacon), 550–1800 kHz (broadcast band), 1.8–4.8 MHz, 4.8–12 MHz, and 12–30 MHz.

The rear panel holds a fuse, a meter-calibration control, antenna and ground terminals, a BFO switch (disconnected), and a square opening labeled "key" (c.w. practice key) with the jack it once held removed to make way for the previously-mentioned jury-rigged phono jack. According to the catalog specifications, the set is supposed to have a BFO pitch control—but I don't see any sign of it. It might have been removed in connection with the phono jack modification. We'll know more when I get the schematic.

All in all, I'd say this was a lot of set for the $40 price tag. In addition to the marine/aircraft beacon and broadcast bands, the radio provided complete shortwave coverage from 1.8-30 MHz, which included all HF amateur bands. The most inexpensive comparable set was the Hallicrafters S-120, the successor to the famous S-38. It sold ready-built for $70 and did not include the marine/aircraft band.

PRELIMINARY TESTS

I started with the tubes, as I usually do. Breaking out my trusty military TV-7 tube checker, I found that the 6BE6, 12AX7, and 6AK6 tested good. The 6HR6 was a bit too new for the TV-7, not appearing on its 1962-era charts. That meant I had to fall back on a newer Eico tester I keep around for

continued on page 92

NEW PRODUCTS

(continued from page 12)

that exhibits the range setting selected by the user. A rotary dial makes function selection easy.

The D-388, complete with test leads, detachable clips, GM and Ford adapters and coil clips, a 9-volt battery, and a detailed instruction manual that covers all diagnostic procedures, costs $84.95. For additional information, contact HC Protek, 154 Veterans Drive, Northvale, NJ 07647; Tel. 201-767-7242; Fax: 201-767-7343; e-mail: hcprotek@aol.com; Web: http://www.techexpo.com/www/hcprotek.

CIRCLE 82 ON FREE INFORMATION CARD

DOLBY PRO LOGIC DECODER WITH LLC

Movie soundtracks are mixed for loud volume levels used in theaters; because the home-theater environment calls for much lower levels, much of the information is lost in the front and surround channels. To compensate for that loss, AMC's Model PRO7 Dolby Pro Logic decoder uses a proprietary low-level compensation (LLC) circuit that allows users to listen to movie soundtracks at significantly lower volume without losing sonic details.

By pressing the LLC button on either the remote control or front panel, the LLC circuit corrects all channels when volume markings fall below 12 o'clock on the level. The LLC circuit adjusts each channel progressively in both amplitude and frequency, so there is no loss of the Dolby sound field when volume is reduced.

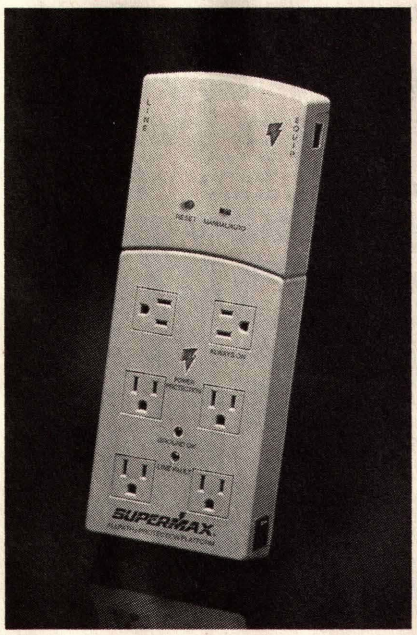
The PRO7 also features a theater-compensation filter to acoustically balance soundtracks that are mixed excessively bright. The amplifier section offers 40 watts for the center channel and 40 watts for the surround channels.

The PRO7 decoder has a suggested retail price of $399.95. For further information, contact AMC, Weltronics Corp., P.O. Box 80584, San Marino, CA 91108; Tel. 800-321-6396.

CIRCLE 83 ON FREE INFORMATION CARD

AC-/TELECOMMUNICATIONS-LINE SURGE PROTECTOR

The *Supermax AllPath* surge protector from *Panamax* safeguards both AC and telecommunications lines for applications sensitive to over/under-voltage. Power is automatically disconnected during over-voltage conditions, such as surges or spikes, or during under-voltage conditions, such as sags or brownouts. The surge protector features the expandable AllPath design, which allows it to be combined with different modules for a variety of applications.



Supermax includes "ground OK" and "line fault" diagnostic lights, an always-on outlet, a master on/off switch, and a six-foot power cord. It has six receptacles plus two modular phone jacks. The Supermax offers an automatic or manual reset when voltage returns to a safe range. It also has a thermal fuse that, in the event of extended overvoltage, shuts off power to connected equipment.

Supermax has a UL 1440 Surge Protection Rating of 330 volts, with an initial clamping level of 200 volts, where the lower the voltage, the better the protection provided. The unit also improves line quality by reducing noise with an EMI/RFI filtration level of 50 dB from 100 kHz to 1 MHz. It is covered by the Panaxax lifetime guarantee and includes a $5-million warranty on properly connected equipment.

The Supermax AllPath has a suggested retail price of $149. For more information, contact Panamax, 150 Mitchell Blvd., San Rafael, CA 94903; Tel. 800-472-5555 or 415-499-3900 (in Canada: 800-443-2391); Fax: 415-472-5540; Web: http://www.panamax.com/panamax.

CIRCLE 84 ON FREE INFORMATION CARD

VEHICLE SECURITY ALARM SYSTEM

The *RF-502* alarm system from *AutoPage* comes with two stylish, two-button, three-channel remote control transmitters. The remote controls give the car owner control of arm/disarm, chirp mute, and optional second- and third-channel functions. Code-rolling technology guards against code-grabbing thieves.

Standard features include a plug-in dual-stage electronic shock/glass sensor with passive/manual arming; parking-light flash; valet/override switch; remote panic alarm; positive and negative trigger inputs; and 120-dB electronic siren. User-selectable functions include ignition-control door locks, door-lock control in passive arming, chirp defeat, and 60-second automatic re-arm after disarm.

The RF-502 vehicle security alarm system has a manufacturer's suggested retail price of $149.95, not including installation. For further information, contact AutoPage, Inc., 1815 West 205th Street, Suite 101, Torrance, CA 90501-1525; Tel. 800-922-2527 in California, 800-262-2527 outside California; Fax: 310-533-0258. ■

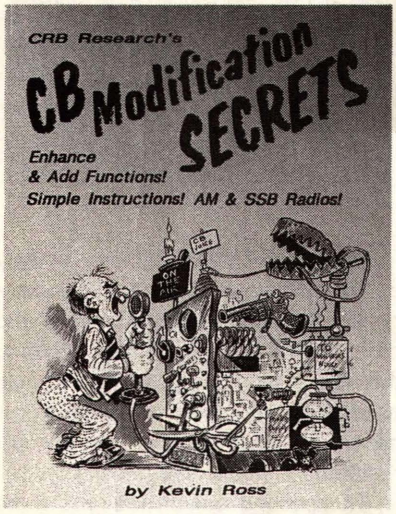
CIRCLE 85 ON FREE INFORMATION CARD

Electronics Library

CB MODIFICATION SECRETS

by Kevin Ross

Recommended by The SSB Network, the world's oldest and largest Single Sideband operator's group, this book shows how to expand, enhance, and add to the usefulness of current and recent AM and SSB gear. Its simple instructions and large, clear illustrations are geared to the average hobbyist using readily available tools and equipment. Tech tips make everything as straightforward as possible.



The book details such enhancements as frequency expansion, SSB clarifier and voice-lock modifications, adding voice control (VOX), a variable frequency oscillator (VFO), an anti-theft transmitter disabler, IF gain control, and a microphone sensitivity control. Other enhancements include a switch to change "Instant Channel 9" to "Instant Channel 19," a receive preamplifier, and a channel-display automatic dimmer and shut-off.

Some of the modifications are designed for specific radios. The others are virtually generic and—to the extent that individual models can be modified—are applicable to more than 200 current and recent CB radios from manufacturers including Cobra, Courier, G.E., Midland International, RadioShack, SBE, Uniden/President, and Wards.

CB Modification Secrets is available for $21.95 plus $5 shipping and handling ($6 to Canada) from CRB Research Books, Inc., P.O. Box 56, Commack, NY 11725; Tel. 800-656-0056 (from Canada, Alaska, and Hawaii, call 516-543-9169). New York state residents must add $2.22 sales tax.

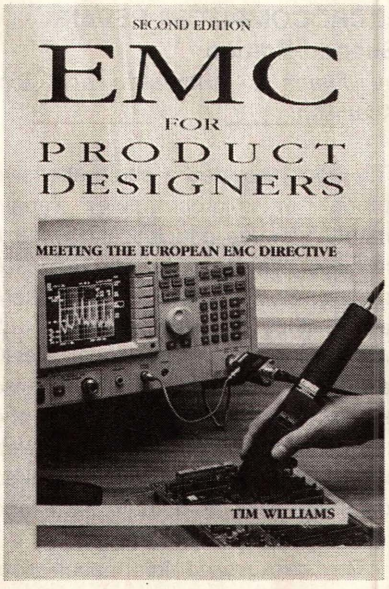
CIRCLE 90 ON FREE INFORMATION CARD

EMC FOR PRODUCT DESIGNERS Second Edition

by Tim Williams

This book provides all the information needed to design products that meet the requirements of the new European EMC (Electro Magnetic Compatibility) Directive. It shows how to incorporate EMC design principles into products, to avoid cost and performance penalties, meet the needs of specific standards, and create a better overall product.

The second edition has been updated to include the latest developments as they affect compliance to the regulations. Particular attention is devoted to new basic, generic, and product-specific test standards; new standards on measurement methods and revisions to existing standards; and changes to the standards generation process. New measurement techniques are also described. The book contains new sections explaining requirements on systems design; the layout of large systems; earthing, grounding, and bonding practices; cable layout, routing, and termination; and components specification. Another new chapter deals with EMC management, covering management requirements, company policy, quality assurance needs, the role of the EMC coordinator, and test and control plans.



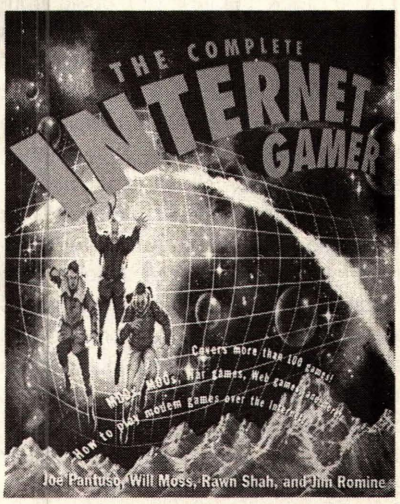
EMC for Product Designers, Second Edition, costs $47.95 and is published by Butterworth-Heinemann, 225 Wildwood Avenue, Unit B, P.O. Box 4500, Woburn, MA 01801; Tel. 617-928-2500.

CIRCLE 91 ON FREE INFORMATION CARD

THE COMPLETE INTERNET GAMER

by Joe Pantuso, Will Moss, Rawn Shah, and Jim Romine

The Internet contains a whole world of interactive games, and this book lets you know precisely where to find more than 100 of them. Written by four well-traveled Internet gamers, the book reveals what hardware and software



you'll need, the latest online tips and tricks, and where to find game magazines ("zines") on the Internet.

The book tells you how to play commercial games over the Internet—even ones that weren't originally designed to be played over the Internet. You'll learn how to play Doom, Descent, and Command & Conquer for free with Kali software. The book shows you where to find the best games—from MUDs to games on the Web—and where to find new games and related software. It provides the complete instructions, rules, and strategies for Netrek, and explains where to find game discussion and news groups. The book offers information on how to get Internet access, tips for surfing the Net, and a brief look at the future of the Internet.

The Complete Internet Gamer costs $24.95 and is published by John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Tel. 800-CALL-WILEY.

CIRCLE 92 ON FREE INFORMATION CARD

A PRACTICAL INTRODUCTION TO ELECTRONIC CIRCUITS
Third Edition

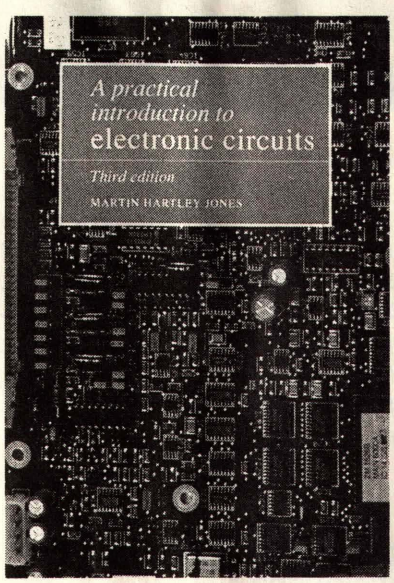
by Martin Hartley Jones

Aimed at anyone with some basic knowledge of electrical circuits, this book provides a practical explanation of electronics. It can be used as a text book for electronics students and as a reference for hobbyists.

The book begins with basic concepts such as amplification; and it's progresses to analog and digital IC applications, including a lucid account of microcomputers. All the topics are illustrated with hands-on experiments, and mathematics is kept to a minimum.

The subject presentation reflects the author's belief that effective learning of electronics must be based on the practical experience of building circuits and experimenting with them. To this end, the circuit diagrams in the book contain sufficient information, such as component values, to allow the reader to learn by experience. Computer experiments are also included.

The third edition maintains the style



and logical subject development of its predecessors, yet reflects recent changes in the field. In those circuits where components have become obsolete, suitable replacements have been introduced. The book includes new sections on switch-mode power supplies, phase-locked loops, and analog-to-digital conversion, and the PC is used in several practical interfacing experiments.

A Practical Introduction to Electronic Circuits, Third Edition, costs $32.95 and is published by Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211.

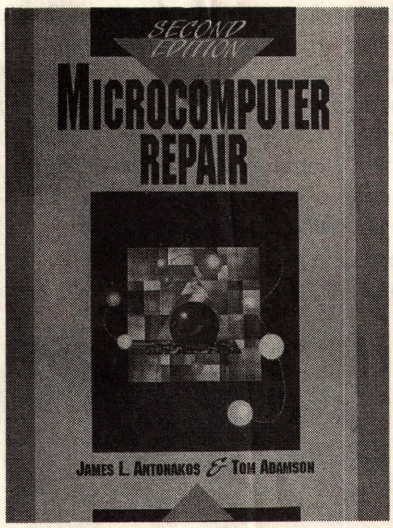
CIRCLE 93 ON FREE INFORMATION CARD

MICROCOMPUTER REPAIR
Second Edition

by James L. Antonakos and Tom Adamson

This book provides a comprehensive tutorial in microcomputer repair. Intended for use in technical classes, it can also be used for do-it-yourself training. Each chapter is a self-contained study exercise complete with hands-on activities, questions, a self-test, and a review quiz. Every exercise begins by stating the new skills and knowledge you will learn by completing it, and describing the required materials (equipment, tools, parts, and software).

The background information section, generally the longest portion of each exercise, presents all the information you'll need to perform the exercise and take the quiz. A self-test, with several different types of questions, helps you check your understanding of the subject; the correct answers are given at the end of the exercise.



Next, a familiarization activity encourages you to gain practical experience. It is followed by questions and other activities designed to reinforce the important concepts you should have learned while completing the hands-on activity. Finally, a review quiz restates the performance objectives.

The second edition features more emphasis on software control; new exercises on CD-ROM, sound modems, and new CPUs; and coverage of new DOS versions.

Microcomputer Repair, Second Edition, complete with companion disk, costs $64 and is published by Prentice-Hall, P.O. Box 11071, Des Moines, IA 50336; Tel. 800-947-7700 or 515-284-6751; Fax: 515-284-2607; e-mail: orders@prenhall.com.

CIRCLE 94 ON FREE INFORMATION CARD

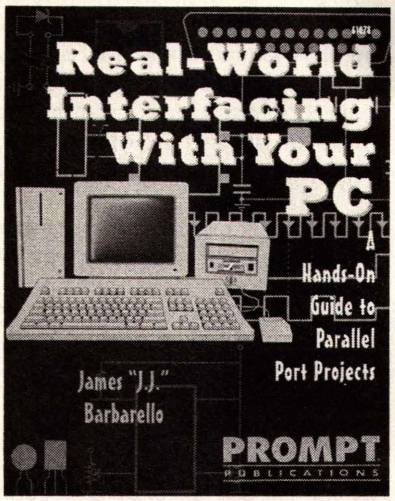
REAL-WORLD INTERFACING WITH YOUR PC:
A Hands-On Guide to Parallel Port Projects

by James "J.J." Barbarello

These days virtually all electronics hobbyists own a personal computer.

And most hobbyists would like to use their PCs for more than just word processing and game playing. What's needed is a basic understanding of how to get electronic signals in and out of the PC.

This book provides electronics hobbyists with all the information they need to use the computer's parallel port as a gateway to real-world electronic interfacing. It begins with an introduction to the computer as an interface device, and describes the parallel port in detail. After presenting the hardware fundamentals, the book explains the basics of writing software to control that hardware.


Real-World Interfacing With Your PC
A Hands-On Guide to Parallel Port Projects
James "J.J." Barbarello
PROMPT PUBLICATIONS

Next, the book shows readers how to design, build, and test an actual project—an analog-to-digital converter. It helps readers learn how to put that new-found knowledge to practical use designing and building their own projects, and even offers advice on how to market those original ideas.

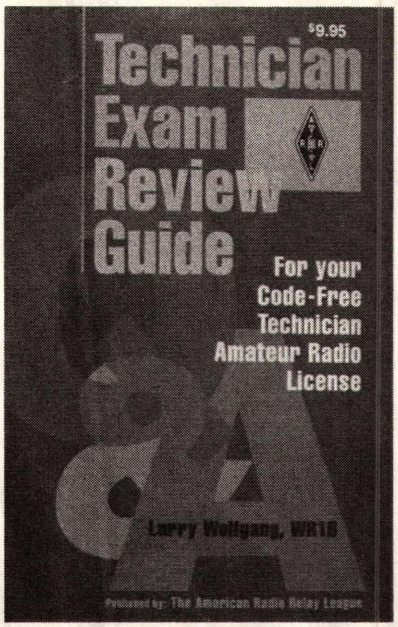
For readers who are not experienced project builders, there's a chapter on construction techniques and a builder's checklist for quick reference. The book also recommends a "starter" inventory of electronic parts to have on hand.

Real-World Interfacing with Your PC costs $16.95 and is published by Prompt Publications, Division of Howard W. Sams & Company, 2647 Waterfront Parkway East Drive, Suite 300, Indianapolis, IN 46214-2041; Tel. 800-428-7267.

CIRCLE 95 ON FREE INFORMATION CARD

TECHNICIAN EXAM REVIEW GUIDE
For Your Code-Free Technician Amateur Radio License
by Larry Wolfgang, WR1B

Now that Morse Code is no longer a requirement, there's never been a better time to get into the exciting hobby of ham radio. And it's easier than ever to prepare for your license exam. The Element 2 and 3A (Novice and Technician) exams required for the Technician class license contain no difficult math, and an electronics background is not necessary. Yet passing those exams entitles you to full operating privileges on every frequency above 50 MHz that is assigned to the Amateur Radio Service. Those include packet radio and even amateur satellites.


$9.95
Technician Exam Review Guide
For your Code-Free Technician Amateur Radio License
Larry Wolfgang, WR1B
Produced by: The American Radio Relay League

This book helps you prepare for the Element 2 and 3A exams. It reviews every question in the Novice and Technician question pools, and provides the answers. In addition, brief explanations help you understand the correct answer to each question.

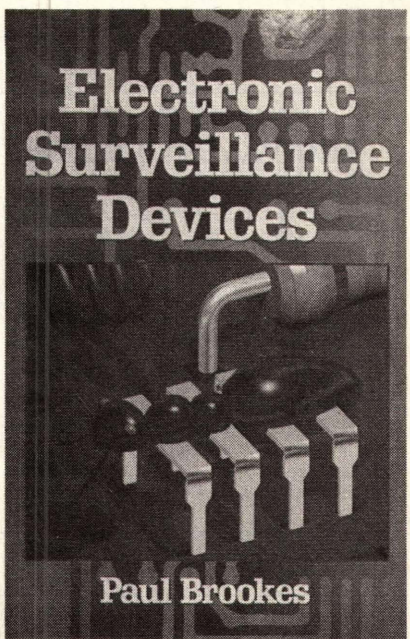
Technician Exam Review Guide costs $9.95 and is published by The American Radio Relay League, 225 Main Street, Newington, CT 06111; Tel. 203-666-1541; Fax: 203-665-7531.

CIRCLE 96 ON FREE INFORMATION CARD

ELECTRONIC SURVEILLANCE DEVICES
by Paul Brookes

By balancing theoretical principles with practical instruction, this book meets the needs of a wide audience, ranging from gadget enthusiasts to anyone involved in corporate security or surveillance.

The book opens with an introductory chapter outlining why various types of devices are used. Two case histories serve as practical illustrations. The second chapter describes all the different types of devices available, and outlines their performance and potential uses.



In the next several chapters, the book provides actual circuit diagrams of various transmitters, recording switches, video devices, and counter surveillance devices. Construction techniques and tips, as well as many thorough parts lists are included. Finally, the book covers the topics of receiving equipment and self-bugging quite well.

Electronic Surveillance Devices costs $29.95 and is published by Butterworth-Heinemann, 225 Wildwood Avenue, Unit B, P.O. Box 4500, Woburn, MA 01801; Tel. 617-928-2500. ■

CIRCLE 97 ON FREE INFORMATION CARD

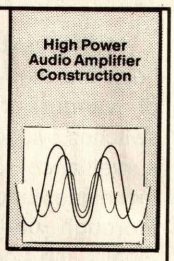
THE COLLECTED WORKS OF MOHAMMED ULLYSES FIPS

#166—By Hugo Gernsback. Here is a collection of 21 April Fools Articles, reprinted from the pages of the magazines they appeared in, as a 74-page, 8½ × 11-inch book. The stories were written between 1933 and 1964. Some of the devices actually exist today. Others are just around the corner. All are fun and almost possible. Stories include the Cordless Radio Iron, The Visi-Talkie, Electronic Razor, 30-Day LP Record, Teleyeglasses and even Electronic Brain Servicing. Get your copy today. Ask for book **#166** and include **$16.00 (includes shipping and handling)** in the US and Canada, and order from **CLAGGK Inc., P.O. Box 4099, Farmingdale, NY 11735-0793.** Payment in US funds by US bank check or International Money Order. Allow 6-8 weeks for delivery. MA05

TRANSISTOR EQUIVALENTS GUIDE

BP85—Designed to help the user find possible substitutes for a popular use-oriented selection of modern transistors. Includes devices produced by more than 100 manufacturers. Wherever possible, equivalents are sub-divided into European, American and Japanese types. Material type, polarity and manufacturer are also shown. To order BP85 send **$9.95 (includes shipping and handling)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. MA08

HIGH POWER AUDIO AMPLIFIER CONSTRUCTION



BP277—Here's background and practical design information on high power audio amplifiers capable of 300±400 watts r.m.s. You'll find MOSFET and bipolar output transistors in inverting and non-inverting circuits. To order your copy send **$6.25 plus $3.00** for shipping in the U.S. and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** U.S. and Canada only. Payment in U.S. funds by US bank check or International Money Order. Please allow 6-8 weeks for delivery. MA03

REFLECTOR ANTENNAS

(Continued from page 44)

9A). Use 300-ohm twin-lead to connect the antenna to the receiver. Or, if you prefer to use coaxial cable, use a 4:1 BALUN transformer between the coax and points X1/X2 (Fig. 9B). A standard television-style 4:1 BALUN transformer is well suited to this application, even though you will have to supply an "F-type" connector at the transformer end of the coaxial cable, and whatever the scanner receiver needs at the other end.

If you don't want to use a TV-style BALUN, then it's possible to use a coaxial cable BALUN as in Fig. 10. The BALUN is made from 75-ohm coaxial cable for 300:75-ohm conversions, and 52-ohm cable for 200:50-ohm conversions. The BALUN section is a half-wavelength long. Calculate the length of the BALUN section as before ($L = 5904/f_{MHz}$), but then multiply that result by the velocity factor (V) of the cable. Typically, regular polyethylene coax has a velocity factor of 0.66, while polyfoam-dielectric cable has a factor of 0.80. Some Teflon cables used at VHF/UHF and microwave frequencies have a velocity factor of 0.70.

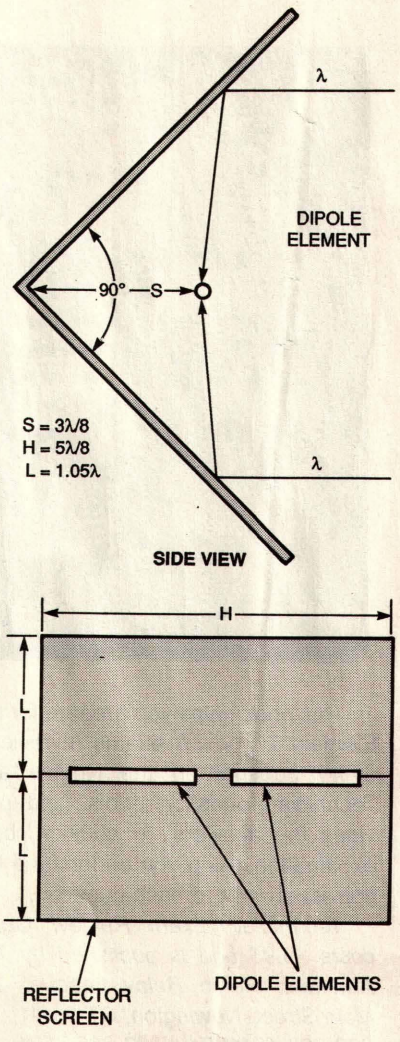


Fig. 11. Here are the front and side views for a corner reflector antenna.

Corner Reflector Antennas. The corner reflector, popular for UHF television reception, also could be designed and built for scanner frequencies. Figure 11 shows the basic corner reflector. It consists of an angled reflector with an angle between 60 and 90 degrees (the 90° version is shown here). When the angle is 90 degrees, the antenna provides about 10 dB of gain, and has a feedpoint impedance of around 72 ohms (which makes a good match to 75-ohm coaxial cable).

The radiator element is a standard half-wavelength dipole (Fig. 2A), placed ⅜-wavelength from the apex of the reflector (distance S in Fig. 10). The width (H) of the reflector is 5λ/8, and the length of each panel (L) is 1.05λ.

As was true with similar antennas that were discussed earlier, the reflector for the corner reflector antenna can be made of either sheet copper or a grid of wires.

Conclusion. Reflector antennas are a way to obtain gains of 3 to 10 dB at low cost and a minimum of effort; all it takes is the use of some handiwork skills. All of the materials are readily available, and there is enough flexibility to allow you to work with the materials you feel most comfortable with. Give one a try and see how much better your scanner's reception can become! ■

"Hello. My name is Kevin, and I'm an Internet addict."

Popular Electronics

Supplement to Popular Electronics
SEPTEMBER 1996

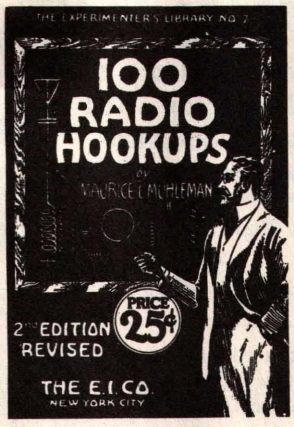
Market Center™

Paperback Books

GREAT BOOKS AT BUDGET PRICES

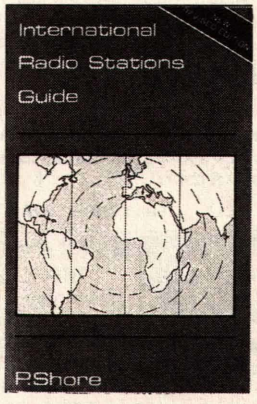
☐ 100 RADIO HOOKUPS —#7—$3.00

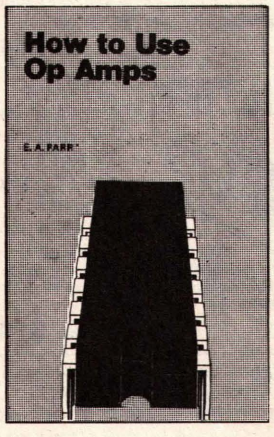
First published in May, 1923 this popular booklet went into reprint editions nine times. It is packed with circuits, theory, antenna installation and tips on consumer radio receivers that were popular in the early 1920's. Antique radio buffs and those inquisitive about the early days of radio will find this booklet an exciting, invaluable and excellent reference into the minds of early-day radio listeners. Sorry, we cannot honor the original 25-cent cover price.



☐ INTERNATIONAL RADIO STATIONS GUIDE—BP255 —$9.95

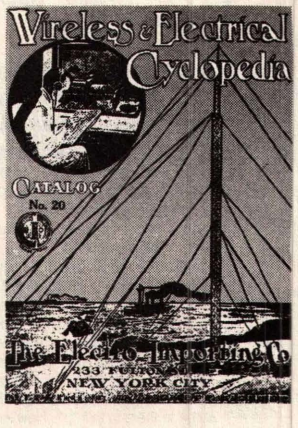
Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed as a guide for listening tothe complex radio bands. Includes coverage on Listening to Shortwave Radio, ITU Country Codes, Worldwide Radio Stations, European Long Wave and Medium Wave Stations, Broadcasts in English and more.





☐ HOW TO USE OP AMPS —BP88—$5.95

The engineer's best friend is the op amp. This basic building block is found in many circuits, analog and digital alike. The op amp finds many useful purposes such as: oscillators, inverters, isolators, high- and low-filters, notch and band-pass filters, noise generator, power supplies, audio, MIDI, and much more. Prepared as a designer's guide, some limited math is used, however engineers and hobbyists alike find it a useful text for their design needs.



☐ WIRELESS & ELECTRICAL CYCLOPEDIA —ETT1—$5.75

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the radio parts and receivers shown, it's very unlikely that it will be available.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____

Address _____

City _____ State _____ Zip _____

SHIPPING CHARGES IN USA AND CANADA

$0.01 to $5.00	$2.00
$5.01 to $10.00	$3.00
$10.01 to 20.00	$4.00
$20.01 to 30.00	$5.00
$30.01 to 40.00	$6.00
$40.01 to 50.00	$7.00
$50.01 and above	$8.50

SORRY No orders accepted outside of USA & Canada

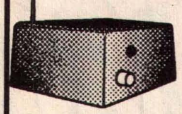
Number of books ordered ☐

Total price of merchandise	$_____
Shipping (see chart)	$_____
Subtotal	$_____
Sales Tax (NYS only)	$_____
Total Enclosed	$_____

All payments must be in U.S. funds! ET01

RAINBOW KITS

Many of our kits are available completely built



FM STEREO TRANSMITTER

Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your CD's while mowing the lawn, Play music on one channel sing on the other. Clarity is excellent, aprox. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls & crystal for stereo separation. 9v battery operation. SIZE: 1.5" x 2.5" x 3"

FMST-100 Cabinet **$8.95** KIT **$29.95**

PHONE TRANSMITTER

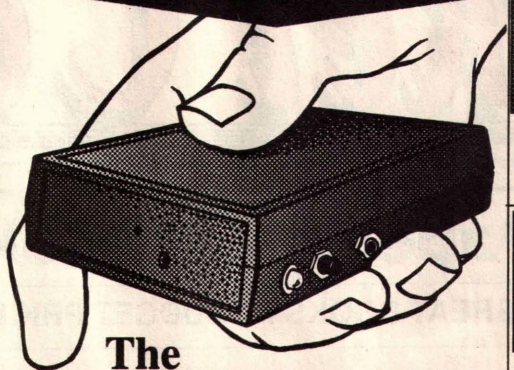
Small but mighty,it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz to 130MHz FM. You can also use it as a speaker phone. SIZE:1.25" x .6".

TEL-B1 BUILT $29.95 KIT **$12.95**

SUPER SNOOPER BIG EAR

Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to12v DC. SIZE:1.75"x 1"

AA-1 BUILT $29.95 KIT **$10.95**



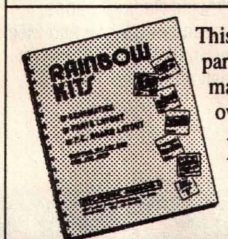
The "ZAPPER II"

With it's new and improved design it will not only test your radar detector... BUT it's tuned to the amateur radio band .

- While your out on American highways personally test yours and your fellow travelers radar detectors.

The "ZAPPER II" is a 10.450 GHz to 10.550 Transmitter

KIT **$39.95** BUILT **$49.95**



This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

KIT BOOK $14.95

$9.95 with the purchase of any kit.

WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12v DC. SIZE: 1.25" x 1"

WM-2 KIT **$14.95**

MICRO-MINIATURE PHONE TRANSMITTER

We haven't seen a smaller phone transmitter than the MMPT2 kit. Powered by the phone, it requires no battery. Transmits both sides of a phone conversation up to a 1/4 mile away.Tunable from 88 to 108MHz FM. Attach it to one phone or add it to the line to pick up all incoming calls. The MMPT2 is undetectable if properly installed. Unit has surface mounted parts, you install the leaded parts. Size .45 "x .6"

MMPT2 KIT **$29.95**

MICRO-MINIATURE WIRELESS MIKE

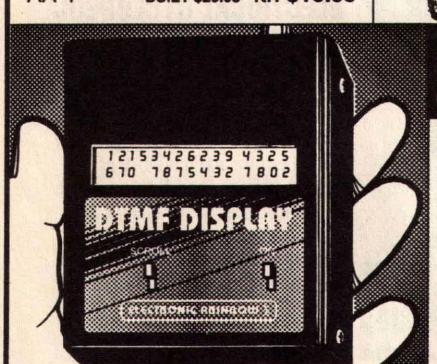
So small you could hide this one on some real bugs! It's the smallest we've ever seen. With it's super sensitive mike it transmits a whisper or a room of conversation to an FM radio, tunable from 88 to 108MHz FM. With a proper antenna it transmits about 1/2 mile. The kit is made with surface mounted parts, we have already mounted these parts. You install the leaded parts. Power requirement 6 to 12v DC. Size .35"x.9"

MMWM5 KIT **$34.95**

STROBE LIGHT

Do you need an attention getter, warning light,or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12v DC . Size 3.5"x1.9"

ST-1 KIT **$11.95**



Press a button and learn every number dialed on your phone

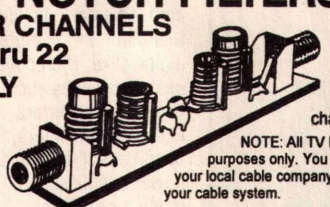
Okay. Caller ID's tell you what number is calling you. But what about the calls made from your phone? Now, return from work or vacation and know the answer. The new DTMF Recorder electronically logs and saves every number dialed. This is the same high-tech magic used by detectives and government spies. Now yours. Does your wife or husband make expensive long -distance calls and then deny it? Does your son or daughter call that low-life you forbade them to talk to? Now know.

- Decodes digits 0 thru 9, #, *, A, B, C, on a 2 line 16 character LCD display.
- Clicks into your phone or extension in seconds, with no special wiring or hassles, or jack it to the incoming service panel in your garage.
- Records all numbers dialed, including local numbers that don't appear on your bill.
- Records credit card numbers entered through your phone key-pad.
- Records Voice mailbox, answering machines, and modem access numbers.
- Records Cellular or repeater phone numbers heard over your phone. Even hook to a scanner, and learn scores of emergency phone numbers. Also decodes tones stored on a tape recorder. Never before has such sophisticated gear been available to the public. And not at this price.

Power requirement 9v DC.SIZE: 3.5" x 4" x 1" **BLACK ANODIZED ALUMINUM CABINET**

DIS-1 KIT **$119.95** BUILT **$159.95**

TV NOTCH FILTERS FOR CHANNELS 2 thru 22 ONLY



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22) only.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

DF-222 KIT **$14.95**

*Please add sufficient postage First lb **$5.00** Canada **$7.00** Additional LB. Add **$1.00** **US FUNDS ONLY***
We will accept telephone orders for Visa or Mastercard

MasterCard **To Order Call 317-291-7262** VISA

ELECTRONIC RAINBOW INC

6227 Coffman Rd. • Indianapolis, IN 46268
FAX 317-291-7269
INTERNET: www.rainbowkits.com

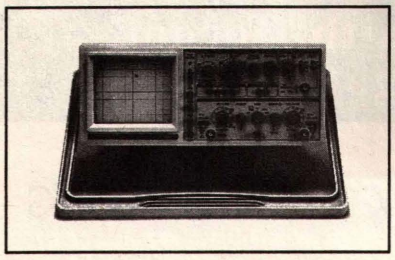
6A

CIRCLE 137 ON FREE INFORMATION CARD

New and Pre-Owned Test Equipment

Substantial SAVINGS on New & Pre-Owned B+K Precision, Fluke, Hewlett-Packard, Goldstar, Leader, Tektronix, and more ...

Goldstar



Model OS-9100P → **$999.00**

Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

FREE SHIPPING!
ON ALL GOLDSTAR EQUIPMENT
ANYWHERE IN THE U.S.
Excluding AK & HI

PROFESSIONAL QUALITY DIGITAL STORAGE OSCILLOSCOPES AT AFFORDABLE PRICES!

Bandwidth	20 MHz	40 MHz	60 MHz
Model	OS-3020	OS-3040	OS-3060
SALE Price	$1,199.00	$1,599.00	$1,899.00

- Transmit and Receive Data with Standard RS-232C Interface
- Includes FREE Comprehensive Communication Software
- Waveform Save, Calculation, and Print
- Dual Channel. Delayed Sweep, TV Synchronization Trigger
- 20 MS/s Sampling Rate, Two Save Memories
- Switch Between Analog and Digital Modes
- CRT Readout Including Measurement Cursors
- Includes Two Probes, 2 Year Warranty

LOWEST PRICES EVER!

NEW FLUKE MULTIMETERS & TEKTRONIX OSCILLOSCOPES

The Industry Standard in Multimeters

Model 75 II ..$128.00	Model 83 ..$232.00
Model 77 II ..$153.00	Model 85 ..$265.00
Model 79 II ..$172.00	Model 87 ..$285.00

NEW! TEKTRONIX TDS SERIES

SUPER SALE!

Pre-Owned Oscilloscope Specials

B+K Precision 1476 10 MHz $229.00
Great Starter Scope!

Tektronix 465	100 MHz	$629.00
Tektronix 465B	100 MHz	$749.00
Tektronix 475	200 MHz	$849.00
Tektronix 475A	250 MHz	$929.00

- The Industry Standard of Oscilloscopes
- Dual Channel, Calibrated Delayed Sweep
- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- 6 Month Warranty - The Longest Available!

B&K PRECISION
MAXTEC INTERNATIONAL CORP.

20 MHz Sweep/Function Generator
Model 4040 $499.00

NEW!

- 0.2 Hz to 20 MHz, 5 digit LED Display
- AM & FM Internal or External Modulation
- Sine, Square, Triangle, TTL, CMOS Outputs
- Burst Operation
- External 30 MHz Frequency Counter

Fotronic Corporation offers the ultimate value in high quality test equipment. Our factory-trained technicians completely refurbish, align, and calibrate all Pre-Owned equipment to the original manufactures specifications. All New equipment shipped from Fotronic goes through a performance test and burn-in. This service is unmatched anywhere. Whether the equipment is New or Pre-Owned our rigorous quality control assures that the product that you purchase will be the best possible. Don't Settle for Second Best! Call today to discuss your requirement.

Full line of Oscilloscopes, RF, Video & Audio Test Equipment, Power Supplies, Meters, Probes and Accessories.

VISA MasterCard AMEX C.O.D.

Availability of Equipment Subject to Prior Sale
Prices Subject to Change Without Notice
Warranty Details Available Upon Request

TOLL FREE 1-800-99-METER
1-800-996-3837

FOTRONIC CORPORATION
P.O. BOX 708
Medford, MA 02155
(617) 665-1400
FAX (617) 665-0780
E-Mail AFoti@msn.com

CABLE TV DESCRAMBLERS & CONVERTERS

Jerrold, Scientific Atlanta, Zenith, Tocom,
Panasonic, Oak, Stargate

*13 MONTH WARRANTY ON ALL PRODUCTS IN WRITING
*QUANTITY DISCOUNTS
*FRIENDLY SERVICE
*30 DAY MONEY BACK

TKA ELECTRONICS
14937 Industrial Road
Omaha, NE 68144

FOR A FREE CATALOG OR QUESTIONS CALL:

1-800-729-1776

MCM ELECTRONICS®

20th Anniversary 1996

Readers Specials!
Take advantage of these tremendous offers on select items for the workbench..
Call today, time is limited!

To take advantage of these offers, you must supply this special price code:

CODE: POP32

Value and Selection From One source...

- Test Equipment from Tenma, Fluke, Hitachi, Leader, B+K
- Name Brand and Low Cost Generic Technician's Tools
- OEM and Generic TV/VCR repair parts
- Over 10,000 American and Original Japanese Semiconductors

MCM offers a full line of tools and test equipment engineered for the repair of computers, TVs, VCRs and more. In addition, you will find a wide variety of TV/VCR parts, passive components and semiconductors, over 25,000 items in all, stocked and ready to ship.

30 Piece Security Screwdriver Kit

SAVE 13%

Ideal for those service applications made difficult by using security screws. Kit contains removal tools for opening many items including IBM PS/2 monitors, cable boxes, telephone equipment and more.

#22-1475
Reg. ~~$39.95~~
Sale $34.95

MCM VCR Repair Tech Disk

SAVE 13%

Ideal for anyone in the VCR Service Business. Contains over 4800 VCR problems with practical repair suggestions. Shows case histories by model number. You can add your own problems and solutions for future reference. Requires DOS 3.0, 1MB hard drive space.

#81-1735
Reg. ~~$39.95~~
Sale $34.95

TENMA®

Digital Solder Station

SAVE 17%

Digital display accurately shows temperature. 320~900°F adjustment and grounded tip make this ideal for most soldering applications.

#21-1590
Reg. ~~$119.00~~ **Sale $99.00**

FREE Catalog

Prices effective September 2 through October 5, 1996

Call Today For your FREE catalog.

1-800-543-4330

Hours: M~F 7 a.m.~9 p.m., Sat. 9 a.m.~6 p.m.,EST.

RCA/GE Premier Distributor

Authorized **Panasonic** Quasar/Technics Original Parts Distributor

MCM ELECTRONICS®
650 CONGRESS PARK DR.
CENTERVILLE, OH 45459-4072
A PREMIER Company

Fast delivery on every order.

CODE: POP32

CIRCLE 151 ON FREE INFORMATION CARD

ALFA ELECTRONICS

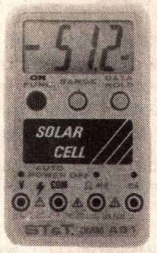
HIGH QUALITY TEST EQUIPMENT
BEST PRICE

DMM 89 $179.00

Most Advanced DMM

All Purpose & Communication

-80.7 to 81.4 dBm with 4Ω – 1200Ω
20 reference impedances
True RMS
Frequency counter: 0.01Hz-10MHz
Capacitance: 1pF-50,000µF
Measure AC volt to 20kHz
5000 counts, 0.1% accuracy
Auto/manual range, fast bar graph
Min/Max/Ave/DH/Relative/Zoom
Auto power off
Input warning
Splash proof
Volt, amp, ohm, logic, diode, continuity
Ruggerdized case
Rubber holster included



DMM A91

~~$49.95~~

NOW $45.00

Plus Free Case

Solar Cell Powered
Large Display

Diode, Continuity
Volt, Amp, Ohm
Data Hold
Auto power off
7 functions, 19 ranges
3.5 Digit, 0.6% accuracy
Auto/Manual ranging
Energy saver
Student & hobbyist's favor

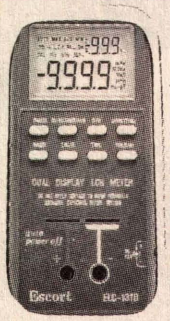
DMM 20 $74.95

Inductance: 1µH-40H
Capacitance: 1pF-200µF
Frequency: 1Hz-20MHz
Volt, amp, ohm, diode, 20 Amp AC/DC current
Transistor HFE
Continuity, duty %
Peak hold/Max
Ruggerdized case
Rubber holster $8.00

Full line of DMMs, economy, compact, ruggerdized, solar cell, automotive, heavy duty, industrial, starts from $19.95

Fluke Multimeter

Fluke 12	$84.95
Holster C-10	$10
Fluke 70 II	$75.95
Fluke 73 II	$97.50
Fluke 75 II	$129
Holster C-70	$16
Fluke 77 II	$155
Fluke 79 II	$175
Fluke 29 II	$175
Fluke 76	$175
Fluke 87	$287
Fluke 867	$1199
Fluke 97	
Scope Meter	$1785
Fluke 105	
Scope Meter	$2799



LCR Meter 131D $229.95

Most Advanced LCR

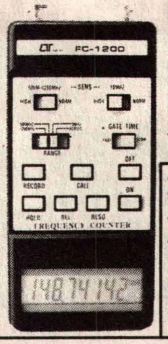
Dual display:L/Q or C/D
Inductance: 0.1µH-1000H
Capacitance:0.1pF-10,000µF
Impedance:1mΩ-10MΩ
0.7% basic accuracy
Auto/manual range
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison and to remove parasitics
Statistics, tolerance,
Best for design, incoming testing & production
SMD and chip component test probe $25.00

LCR Meter 814 $189.95

Best Resolution LCR

Inductance: 0.1µH-200H
Capacitance: 0.1pF-20,000µF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics
Best for high frequency RF
SMD and chip component test probe $25.00

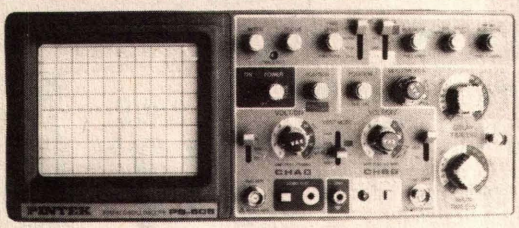
LIMITED QUANTITY SPECIAL
DIGITAL LCR 680 $74.95
0.1pF, 1µH, 10mΩ resolution



Frequency Counter FC-1200 $129.95

Frequency:0.1Hz-1.25GHz
Display: 8 digit LCD
Period: 0.1µs-0.1s
Records Max/Min/Average
Data hold, relative mode
Telescoping antenna $8.00
Deluxe case $5.00

Also Available:
AC/DC clamp meter, Light meter, Thermometer, pH meter, High voltage probe, Digital caliper, Anemometer, Electronic scale, Force gauge, Tachometer, Stroboscope, Humidity & EMF adapter, Sound level meter, Frequency counter, SWR/field strength/power meter, Dip meter



20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule illum, 2 probes each has x1,x10 switch. Best price with delay sweep.

PS-200	20 MHz DUAL TRACE	$339.95
PS-400	40 MHz DUAL TRACE	$494.95
PS-405	40 MHz DELAY SWEEP	$569.95
PS-605	60 MHz DELAY SWEEP	$769.95
PS-1000	100 MHz DUAL TRACE	$999.95

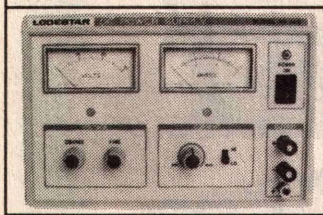
Scope Probe: 60MHz x1, x10 $15, 100MHz x1, x10 $22
250MHz x1, x10 $29, 250MHz x100 $39

Digital Storage Scope

DS-303 30MHz, 20M Sample/sec $849.95

DS-303P with RS-232 interface $1,049.95

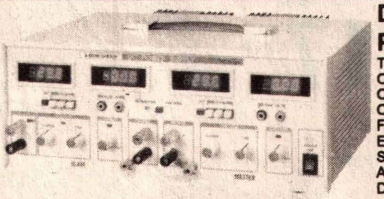
Switchable between digital and analog modes
2 K word per channel storage
8 bit vertical resolution (25 Lerel/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all , Save CH2, Pre-Trig
Plotter control



DC Power Supply PS-303 $159.00

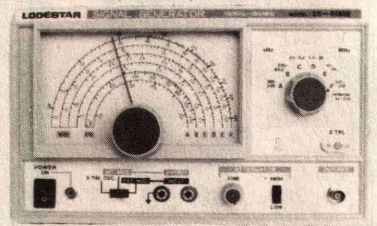
0-30 VDC , 0-3A output

Constant voltage & constant current mode
0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter $179.00
Also available: 30V/5A, 60V/3A, 60V/5A 16V/10A, 30V/10A



DC Power Supply Triple Output PS-8202 $499.95

Two 0-30 VDC , 0-3A outputs
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output $549.95
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



RF SIGNAL GENERATOR SG-4160B $124.95

100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
Audio output 1 kHz, 1 Vrms

RF SIGNAL GEN./COUNTER SG-4162 AD $229.95

Generates RF signal same as SG-4160B
6 digit frequency counter 1Hz - 150 MHz for internal and external source Sensitivity <50mV

AUDIO GENERATOR AG-2601A $124.95

10Hz - 1MHz in 5 ranges
Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05% 500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

AUDIO GEN./COUNTER AG-2603AD $229.95

Generates audio signal same as AG-2601A
6 digit frequency counter 1Hz-150MHz for internal and external sources Sensitivity <50mV

FUNCTION GENERATOR FG-2100A $169.95

0.2 Hz -2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1

FUNCTION GEN/COUNTER FG-2102AD $229.95

Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

SWEEP FUNCTION GEN./COUNTER $329.95

0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 6 digit counter
1Hz-10MHz for internal & external sources

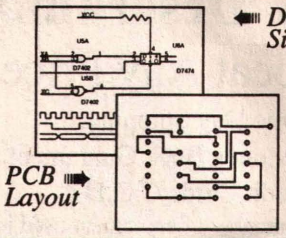
ALFA ELECTRONICS
741 Alexander Rd., Princeton, NJ 08540

(800) 526-2532/(609) 520-2002
FAX:(609) 520-2007

15 DAY MONEY BACK GUARANTEE. 1 YEAR WARRANTY
CALL OR WRITE FOR FREE CATALOG
Visa, Master Card, American Express, COD, Purchase Order Welcome

CIRCLE 26 ON FREE INFORMATION CARD

Low Cost CAD Software
for the IBM PC and Compatibles
Now In Windows™



Design & Simulation

PCB Layout

- Easy to use schematic entry program (SuperCAD) for circuit diagrams, only $149. Includes netlisting, bill of materials, extensive parts libraries, More parts, and automatic wiring available in enhanced CAD package (SuperCAD+) for only $249.
- Powerful, event-driven digital simulator (SuperSIM) allows you to check logic circuitry quickly before actually wiring it up. Works directly within the SuperCAD editor from a pulldown menu and displays results in "logic analyzer" display window. Starting at $149 this is the lowest cost simulator on the market. Support for PALs, a larger library, and a separate interactive logic viewer are available in full-featured SuperSIM+ for only $399. Library parts include TTL, CMOS and ECL devices.
- Circuit board artwork editor and autorouter programs (SuperPCB), starting at $149. Produce high quality artwork directly on dot matrix or laser printers. You can do boards up to 16 layers including surface mount. Includes Gerber and Excellon file output. Autorouter accepts netlists and placement data directly from the SuperCAD schematic editor.
- Low cost combination packages with schematics and PCB design: 2-layer for $399, 16-layer for $649.
- DOS version available.

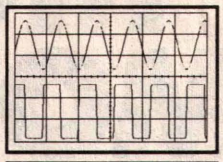
Write or call for free demo disks:

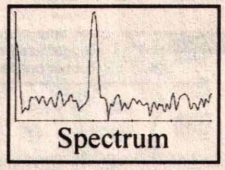
MENTAL AUTOMATION INC.

5415 - 136th Place S.E.
BBellevue, WA 98006
(206) 641-2141 • BBS (206) 641-2846
http://www.mentala.com

OSCILLOSCOPES
from $169 !!!

ATC O-Scope uses printer port to turn PC-AT into Digital Storage Oscilloscope, Spectrum Analyzer, Freq. Counter, Logger, DVM. DC-500KHz





- Print, log to disk, or export data
- Accepts standard scope probes
- Uses standard printer port
- Small and portable
- Works with laptops
- Same day shipping
- Made in U.S.A.

- Single channel units from $169
- Dual channel units from $349

Options:
- Probe sets
- Automotive probes
- Battery packs

Order yours today.

800 980 9806 MC/Visa/Amex

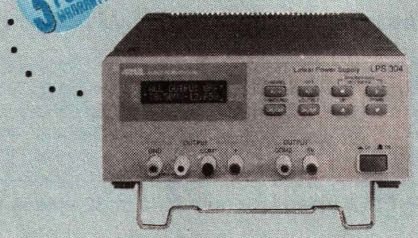
Allison Technology Corporation
8343 Carvel, Houston, TX 77036 USA
PH: 713 777 0401, FAX: 713 777 4746, BBS: 713 777 4746
http://www.atcweb.com

AMERICAN RELIANCE

AMREL Offers Lowest Prices & Best Warranties on DC Power Supplies ANYWHERE!

AMREL Offers Superior Analog Power Supplies Starting as Low as $149.00

- Low Output noise rating less than 0.3mV.
- Line/load regulation rated at low 0.01% + 1mV.
- Transient response time of 50μ Sec.
- Overload protection, and Output enable/disable.
- Coarse and fine voltage/current adjustment.
- Auto series/parallel operations for triple output supplies.



AMREL Offers Features And Prices on Digital Power Supplies That The Competition Can't Beat!

- Microprocessor controlled.
- User friendly keypad data entry.
- Low output noise rating less than 1mV.
- Line/Load regulation rated less than 2mV.
- Output enable/disable and Power off memory.
- Optional RS-232 interface capability.

Model	LPS-101	LPS-102	LPS-103	LPS-104	LPS-105	LPS-106	LPS-301	LPS-302	LPS-303	LPS-304	LPS-305
Rating	30V/1A	30V/2A	30V/3A	+30V/1A -30V/1A 3-6.5V/3A	+30V/3A -30V/3A 3-6.5V/3A	60V/1A	15V/2A(H) 30V/1A(L)	15V/4A(H) 30V/2A(L)	30V/3A	+30V/1A -30V/1A 5V/2A	+30V/2.5A -30V/2.5A 3.3-5V/3A
List Price	$195	$225	$295	$395	$495	$245	$249	$299	$369	$399	$599
Sale Price	$149	$179	$199	$375	$469	$219	$199	$285	$350	$379	$569

PRINT™ Products International Inc.

Call: 1-800-638-2020 VISA MasterCard

8931 Brookville Road • Silver Spring, Maryland 20910 • Fax: 800-545-0058 •

CIRCLE 46 ON FREE INFORMATION CARD

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radiotelephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School

This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 240

COMMAND PRODUCTIONS
FCC LICENSE TRAINING, Dept. 240
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

Don't rent own!

Cable TV Descramblers

We'll beat Any Price!

- Same Day Shipping!
- 30 Day Money Back Guarantee!
- Credit Cards/C.O.D.

Have make and model number of equipment used in your area

REPLACEMENTS FOR MOST SYSTEMS

CALL TOLL FREE

CABLE DISCOUNT

1-800-684-9135

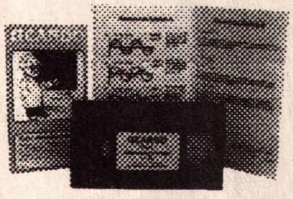
NO NEW JERSEY SALES!

Anyone implying theft of service will be denied assistance.

Take Stock in America **U.S. SAVINGS BONDS**

A public service of this magazine

Electronic Training Videos



Learn electronics quickly and easily with **UCANDO**'s computer-animated training videos. Students can learn at their own pace and professionals will find the **UCANDO** videos to be a valuable source of reference material. If these videos aren't the best learning tools you've ever seen, return them within 30 days for a complete refund. These videos are being used by Tech-Schools, CET's, Military Branches, Ham Operators, Industries, and more, across the United States and around the world. **Order today** and see how **UCANDO** is ...

"Changing The Way The World Learns Electronics."

VCR Maintenance & Repair ... $29.95 All others ... $44.95 each
• Intro to VCR Repair • Direct Current • Alternating Current • Semiconductors • Power Supplies • Amplifiers • Oscillators • Digital 1 • Digital 2 • Digital 3 • Digital 4 • Digital 5 • Digital 6 • AM Radio • FM Radio Part 1 • FM Radio Part 2 • TV Part 1 "Intro to TV" • TV Part 2 "The Front End" • TV Part 3 "Audio" • Fiber Optics • Laser Technology •

SAVE!!! 6 videos for only $240 or 12 videos for only $450

VISA MasterCard

1-800-678-6113

or mail check or money order to:

UCANDO Videos
P.O. Box 928
Greenville, OH 45331

FREE Shipping ... FREE Catalog

CIRCLE 136 ON FREE INFORMATION CARD

Are Cable Companies Sucking You Dry?

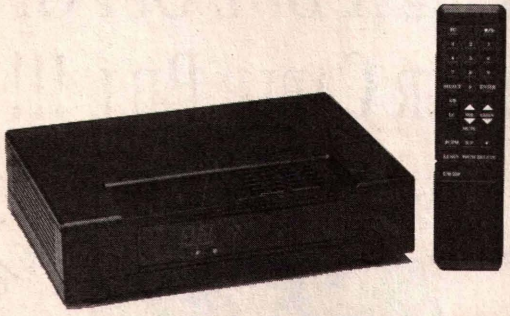
FREE Catalog!

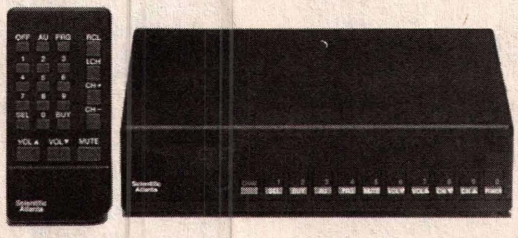
All Major Brands!

Take a Bite out of High Rental Fees

with your own

Converters & Descramblers





Everquest • Panasonic • Jerrold • Zenith • Pioneer • Scientific Atlanta • Oak • Eagle • Hamlin • Tocom

DISCOVER VISA MasterCard

Order Toll-Free **1 800 624-1150**

Call today for a FREE catalog!

NCCA Member of National Consumer Cable Association

MD Electronics

NCCA Member of National Consumer Cable Association

875 S. 72 Street • Omaha, NE 68114

® JERROLD, STARCOM, PANASONIC, ZENITH, PIONEER, OAK, SCIENTIFIC ATLANTA, EAGLE, HAMLIN, and TOCOM are all registered trademarks. All references to the above mentioned equipment is for identification purposes only. We are in no way implying that any of the products in this advertisement are original equipment. M.D. Electronics is in no way affiliated with the above mentioned companies or corporations.

Toll Free, 24 Hours! For orders, dial 800 445 7717. For Fax Facts Instant catalog sheet service, dial 317 849 8683. Computer BBS 317-579-2045. Fax: 317 849 8794. Email: ACESCANS@aol.com. Mastercard, Visa, Checks, Approved P.O.'s & COD (add $5.50) & AMEX, Discover. Prices, specs and availability subject to change. Ground shipping and handling charge $6.95.

10707 E. 106th St. Fishers, IN 46038

ACE COMMUNICATIONS

CIRCLE 33 ON FREE INFORMATION CARD

FEI Forest Electronics Inc.

Are you overpaying . . .

. . . your cable company?

You are if . . .

. . . you are leasing their equipment.

- *Forest Electronics, Inc. offers a complete line of New Cable Decoders and Converters that are fully Compatible with your cable system.*
- *All systems come with: Remote Control, & Parental Guidance Feature. Volume Control is also available.*
- *All Equipment is fully guaranteed & comes with a 30 day money back option.*

For More Information Call Us 24 Hours a Day At:

800-332-1996

FAX: 708-860-9048

TAKE A BITE OUT OF YOUR CABLE BILL !!!

CABLE BOXES & DESCRAMBLERS

1(800) 72-BOXES

SKYVISION®

1048 Frontier Drive Fergus Falls, MN 56537 Fax: 218-739-4879

DIGITAL is the Future

Introducing. . .

"The New Kid on The Block"

18" DIGITAL DISH

We've been hearing a lot lately about the new little dishes. The DISH℠ Network System is the latest, and he arrived as a shining star. He is small, attractive and the latest in technology, but what really sets him apart is the programming he delivers to your Television screen. The DISH℠ Network is chock full of the most popular programming at prices much lower than the competiton. Call us now for more information. Digital just may be in your future.

dish NETWORK

The Dish is Small The Programming BIG

Beat The Rush Call Now

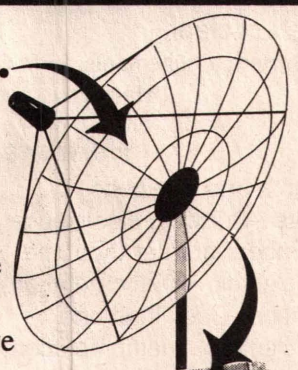
800-500-9264

Special Digital Hotline

30%-60% Savings! Compare to Other 18" Dish Programming!

If you have one of these. . .

"Keep it Running Strong" With a Discount Buyer's Guide



If you are the owner of a C/Ku-band Full View Satellite System, we know you'll want to keep it up and running strong. The Skyvision Discount Buyer's Guide will give you advice and products to get the job done right.

You Will Find a Wide Selection of:

- **Complete Systems**
- **Advanced Upgrades**
- **Parts & Accessories**
- **Tune-Up Tools & Advice**
- **Technical Tips Galore**
- **Discount *Skypac*℠ Programming**

For Your Free Issue Call Now

800-334-6455

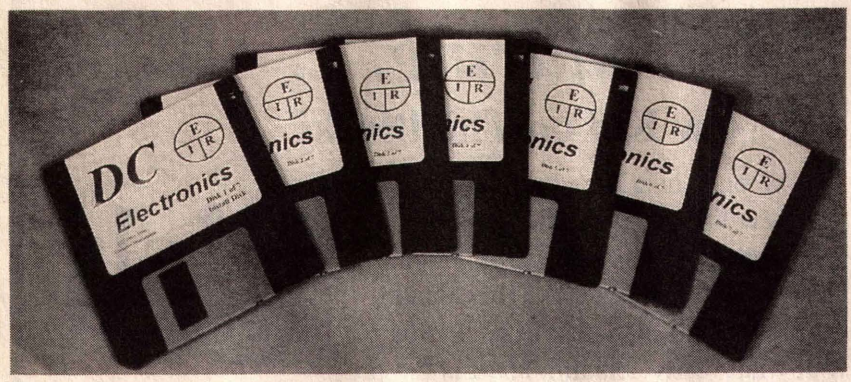
Need a repair item Fast??

"We'll Get It Out Today"

The most complete Big Dish Satellite Discount Buyer's Guide! Get your FREE copy now

Discover DC Electronics

17-Module Course -- Only $49.95



Contains everything you ever needed to know about DC electronics. Whether you are a professional working in electronics and you want a review of the basics, or a student or hobbyist new to this field and need a good self-paced course, this is the perfect way to get started.

The course starts with basics and assumes you know nothing about electronics. It teaches the required math, how to use a scientific calculator. and the metric notation system. Each module has been written by an electronics instructor, and will directly from a floppy or from a menu-driven system on your hard drive. Every module includes a review, summary, quiz, and a final exam that can be printed out. Important points are animated to make the explanation clear.

System requirements: IBM Compatible, 512K RAM, VGA Color, Hard Drive and DOS 3.2 or newer.

Here are the Modules

1. Atoms and Electrons
2. Volts / Current / Resistance
3. Numbers greater than one Scientific - metric notation
4. Numbers less than one Scientific - metric notation
5. Resistor Color Codes
6. Using Calculators
7. Ohms Law and Power
8. Series Circuits
9. Parallel Circuits
10. Series / Parallel Circuits
11. Voltage Dividers
12. Kirchhoff's Law
13. Advanced DC Circuit Analysis
14. Capacitors / RC Time Constants
15. Introduction to Magnetism
16. Inductors and L/R Time Constants
17. Volt/Ohm/Current Meters

Claggk Inc. P.O. Box 4099, Farmingdale, NY 11735

Send me my course, today! Charge me the special introductory price!

Name _____

Address _____

Address _____

City _____ State _____

Zip _____

Payment Enclosed $ _____

Check [ ] Money Order [ ] Credit Card [ ]

New York residents add local sales taxes. Canadians add $6 per order. Credit card orders by phone or fax. Automated telephone orders 516-293-3751. Fax 516-293-3115. Allow 4 to 6 weeks for delivery.

$49.95 + $4.95 shipping

Credit Card Info

[ ] MC [ ] Visa

Card # _____

Exp Date _____

Signature _____

GIANT! ENTHUSIAST'S SPY ELECTRONICS CATALOG

Just Like In The Movies!
Fiber-optics• IR Detectors•UV Powder
Covert TV Cameras• Phone Transmitters
Laser/Parabolic Mic's•Nightvision• Wrist Watch Cameras•Time Lapse VCR's, Surveillance-Counter Surveillance•Homing Xmitters•Fiberscopes• Police Electronics•Micro-TV's• Phone Bug's• TV Xmitters Transmitters• Books/Video's and Much, Much More!

SECRET **EVIDENCE LOCATER**
Just whistle your secret code and it whistles back
$7.77+2.00 S&H

CATALOG ***Rush!*** **$5.00 to CI ASSOCIATES**
2801PE Shelterwood, Arlington, TX 76016

SILICON-CONTROLLED RECTIFIER PROJECTS

1586T—From TAB Books. A treasure trove of exciting projects using SCR's and other low-cost thyristor devices for power-control applications. Includes a sophisticated burglar-alarm system, an SCR-based smoke- alarm system, a remote-control garage-door opener, and a high-tech light dimmer that uses the output from your stereo to modulate the intensity of your lights. And then there are 20 more. To order—ask for book **1586T**, and include your check for **$12.95 (includes s&h)** in US and Canada, and order from — **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only, use US bank check or International money order. Allow 6-8 weeks for delivery.

MA09

Yours for only $3.50

Prices includes shipping!

HAVE A THOUSAND YUCKS FOR ONLY THREE AND A HALF BUCKS! That comes to one-third of a cent per laugh. Electronics Comics is a compilation of over 125 riotous, outrageous and phenomenal cartoons that appeared in **Popular Electronics** and **Electronics Now**. Only **$3.50**—price includes shipping. **Claggk, Inc., Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735-0793.** All payments in U.S. funds. Sorry, no orders outside U.S.A. and Canada. Check or money order only—send no cash. NY state residents add applicable tax.

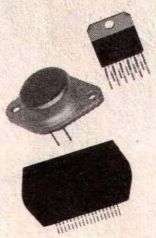
MA04

DALBANI

$20 MINIMUM ORDER
CALL NOW FOR YOUR
232 PAGE FREE CATALOG
1-800-325-2264

HOT PRICES ON POPULAR SEMI'S

Order Nº	Brand	Min	Price
BU-208	TESLA	10	$1.49
BU-208/O	TOSHIBA	1	4.50
2N-3055	TESLA	10	0.60
2N-3773	TESLA	5	1.20
2SD-1398	SANYO	10	1.49
2SD-1650	SANYO	5	1.69
STRD-1005	SANKEN	1	4.15
STR-30130	SANKEN	1	2.66
STRS-6301	SANKEN	1	8.50
TA-7777N	TOSHIBA	1	6.96
TDA-2005	SGS	5	1.49



COLOR CODED LEADS HEAVY DUTY

$2.82

ORDER Nº 56-500

- 11" Long Wire Lead
- Insulated 1 1/2" Alligator Clips
- 20 Gauge Wire Size • 10 Leads
- BLACK, GREEN, RED,YELLOW, WHITE

SOLDER WICK

- Solder Remover
- Length 5 Feet

85¢
Min. 2 pcs.

ORDER Nº 51-1050

CODE PE96
PLEASE MENTION WHEN ORDERING

Items are subject to availability. Prices are subject to change without any prior notice.

FLYBACK TRANSFORMERS

$12.50

Replaces GOLDSTAR 154-074R

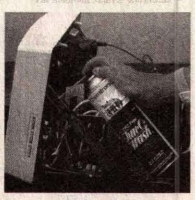
ORDER Nº 63-0189

TUN-O-WASH®

Chemtronics

ORDER Nº 30-0100

$7.50 (CFC Free)



Fast drying electronics grade cleaner for tuners, controls and PC boards.

TUN-O-WASH is excellent cleaner and degreaser for tuners, controllers and PC boards.

- Designed for cleaning and degreasing consumer electronics • Cleans in one step, no rinsing required • Contains no ozone depleting compounds • CFC and HCFC free
- Not for use on energized equipment
- 12.5 Oz aerosol (12 cans per case)

VCR ALIGNMENTTOOL KIT

ORDER # 50-888

The most popular

$24.99

- VCR Head puller
- Retaining ring remover
- Spring hook
- Micro screwdriver
- Hex key set • Fitted vinyl • Soft zippered case
- Dimensions: 91/2"(W) X 121/4"(L)
- 7 Assorted head & guide aligners
- 3 Reverseable screwdrivers (Small-Flat-Philips)

TEMPERATURE CONTROLLED SOLDERING STATION

$64.00

- Adjustable Temp.: 300°F - 790°F - 150°C - 480°C
- Grounded Tip for Soldering : Static Sensitive Devices, Heater Aid.
- Led Power Temperature Indicator
- Overheat Protection W/ Temperature Control
- Auxiliary Grounded Terminal
- Comes in digital LED display
- 48 Watts soldering iron

ORDER Nº 51-1035

UNIQUE REALTIME OSCILLOSCOPE BUILT-IN FUNCTION GENERATOR

Manuf # **OS-9020G**

20MHz 2-CH DUAL TRACE

Order Nº 50-820

1 MHZ FUNCTION GENERATOR

$498.00

Features

• Wider than specified frequency response • High deflection factor of 1mV/div.• Wide dynamic range up to 30MHz without waveform distortion • Algebric sum of CH1 and CH2 • Low drift with compensation circuit • Superb trigger sensitivity • Maximum sweep rate of video signals with internal TV sync. separator • Jittless trigger circuitry • CH1 signal output terminal available • Variable trigger hold-off • High precision X-Y phase difference measurement up to 50kHz • Built-in function generator with BNC output of 50Ω and TTL • Three kinds of waveform are available with 50Ω output • Flat output waveform frequency up to 1MHz

Specifications:

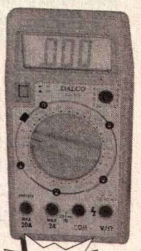
Vertical deflection: • Bandwidth :DC coupled (DC to 20MHz normal), AC coupled :(10Hz to 20MHz normal) • Deflection factor: 5mV/div to 5V/div in 10 calibrated steps of 1-2-5 sequence • Rise time: 17.5nS or less

Horizantal deflection: • Time Base A: 0.2µs to 0.2S/div in 19 calibrated steps.1-2-5 sequence • Uncalibrated continuous control between steps of at least 1: 2.5.

DIGITAL MULTIMETERS

NEW! *Digital*

DALCO



- Overload protect 1000VDC or peak AC on all other ranges
- Input impedance 10M Ohm on all ranges • Base accuracy range ± 0.5 % to ± 1.0 % • Resistance 200Ω, 2K, 20K, 200K, 2M, 20M
- Audible continuity response lower than 50Ω • DC Voltage 200mV, 2V, 20V, 200V, 1000V AC Voltage 200mV, 2V, 20V, 200V, 700V

ORDER Nº 50-815

$19.95

LOGIC Probe

ORDER Nº 51-1015

$8.99

- Length: 8 inches
- Range: 4.5 To 15 VDC
- Includes Test Leads • Compatible With TTL,DTL,RTL,HTL,CMOS, NMOS Logic

SOLDER ROLL

- 1 LB Spool
- 370 deg F melting point
- Fastest solder
- Alloy 60/40, tin lead, non corrosive flux, Diam. 1.2mm

ORDER Nº 51-1005

$3.95

Universal Audio/video Remote

ORDER Nº 82-1055

• Controls basic functions of TV, VCR, cable box, and CD or laser player • Ergonomic design! Main buttons are in line with natural thumb motion • Two-minute memory allows time to replasce batteries without reprogramming • Programming reminder sticker inside battery compartment • Sleep time for 60, 30, or 15 minutes(according to your TV) • Set key recessed to prevent accidental deprogramming • Spanish instruction included. • Requires four AAA Batteries (not included)

MAGNAVOX
Smart. Very smart

$9.95

- **Cable (11 brands)**
- **VCR (68 brands)**
- **TV (77 brands)**
- **Compact disc and Laser Disc (94 brands)**

4225 N.W. 72nd AVE MIAMI, FLORIDA 33166 TEL : (305) 716-1016 FAX : (305) 594-6588

CIRCLE 139 ON FREE INFORMATION CARD

TIPS FOR MAIL ORDER PURCHASE

It is impossible for us to verify the claims of advertisers, including but not limited to product availability, credibility, reliability and existence of warranties. The following information is provided as a service for your protection. It is not intended to constitute legal advice and readers are advised to obtain independent advice on how to best protect their own interests based upon their individual circumstances and jurisdictions.

1. Confirm price and merchandise information with the seller, including brand, model, color or finish, accessories and rebates included in the price.

2. Understand the seller's return and/or refund policy, including the allowable return period, who pays the postage for returned merchandise and whether there is any "restocking" or "return" charge.

3. Understand the product's warranty. Is there a manufacturer's warranty, and if so, is it for a U.S. or foreign manufacturer? Note that many manufacturers assert that, even if the product comes with a U.S. manufacturer's warranty, if you purchase from an unauthorized dealer, you are not covered by the manufacturer's warranty. If in doubt, contact the manufacturer directly. In addition to, or instead of the manufacturer's warranty, the seller may offer its own warranty. In either case, what is covered by warranty, how long is the warranty period, where will the product be serviced, is there a charge for service, what do you have to do to obtain service and will the product be repaired or replaced? You may want to receive a copy of the written warranty before placing your order.

4. Keep a copy of all transactions, including but not limited to cancelled check, receipt and correspondence. For phone orders, make a note of the order including merchandise ordered, price, order date, expected delivery date and salesperson's name.

5. If the merchandise is not shipped within the promised time, or if no time was promised, within 30 days of receipt of the order, you generally have the right to cancel the order and get a refund.

6. Merchandise substitution without your express prior consent is generally not allowed.

7. If you have a problem with your order or the merchandise, write a letter to the seller with all the pertinent information and keep a copy.

8. If you are unable to obtain satisfaction from the seller, contact the consumer protection agency in the seller's state and your local Post Office.

If, after following the guidelines, you experience a problem with a mail order advertiser that you are unable to resolve, please let us know. Write to Advertising Department, Gernsback Publications Inc., 500B Bi-County Blvd. Farmingdale, NY 11735.

Be sure to include copies of all correspondence.

ANTIQUE RADIO

(continued from page 73)

later tubes. The Eico is not as sophisticated as the TV-7, being just a simple emission tester. But then, I don't run into many newer-than-1962 tubes either. In any case, the Eico gave the 6HR6 a clean bill of health.

The next thing I normally check when going through a radio is the power transformer (if present). Normally I pull out the rectifier tube before doing this because I do not want voltage applied to the vintage filter caps, which are likely to be leaky. The Star Roamer was a little too new to have a rectifier tube, being equipped with a selenium-stack diode instead. So I just went ahead and clipped one of the leads to the diode. I'll probably want to eventually replace it with a more reliable silicon diode, anyway.

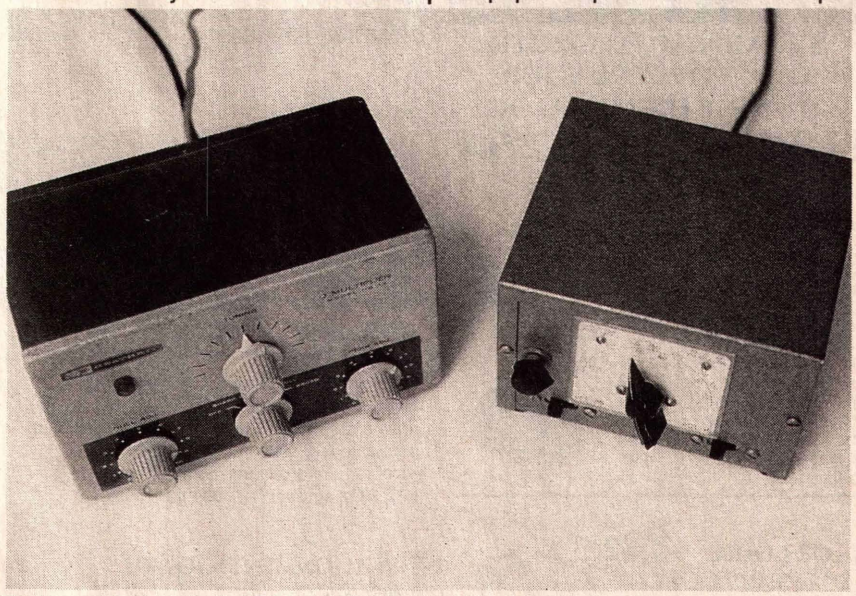
Plugging in the set, I switched it on and was pleased to see the glow of the twin pilot lights (one on either side of the slide-rule dial). That meant that the transformer's filament winding was okay. Then I connected a multimeter to the transformer's high-voltage secondary and read a voltage of 127. It seemed a little low, but transformer secondaries are usually good or bad—not in-between—so I'm assuming we are okay here. More on this when the documentation arrives.

WHAT'S NEXT?

My next moves on the Star Roamer, as with any vintage radio, will be cosmetic cleaning, housekeeping, and correction of obvious physical problems. I'll clean and polish the cabinet and front panel, remove the grime from the top of the chassis, and treat all of the potentiometers and switches with contact cleaner. There's a split control knob that needs attention, not to mention that cracked rear panel.

This is also the time for replacement of doubtful components. If the line cord and/or plug were defective (not a problem in this case), now would be the time to change it. All electrolytic filter capacitors are replaced on sight, as are all wax-coated paper capacitors. Such components are prone to leak—degrading set performance—or even fail, taking difficult-to-replace power or IF transformers with them. Luckily the Star Roamer's bypass and filter capacitors are ceramic-disc types, so wholesale recapping will not be required. There *is* a multi-section filter capacitor that will have to be replaced by four individual units (an exact replacement would be virtually unobtainable, of course).

Taking care of details like those up front greatly increases the odds that your radio will play the first time you plug it in. And, even if it doesn't, I can guarantee you that the troubleshooting process will be greatly simplified. ■



The Heath "Q Multiplier" (left) and the Holstrom Associates preselector, found along with the Star Roamer, were apparently used as accessories for it.

Have you ever given a gift
so wonderful,
someone carries it with them
the rest of their life?

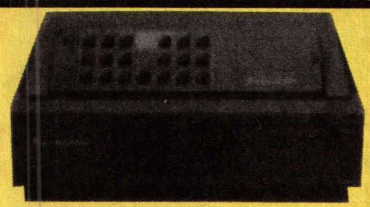
Please give blood.
There's a life to be saved right now.

Call 1-800 GIVE LIFE

Ad Council

American Red Cross

CABLE TV DESCRAMBLERS



WE CARRY A FULL LINE OF PREMIUM CONVERTERS AND DESCRAMBLERS
- Scientific Atlanta™ Compatible
- Jerrold™ Compatible
- Tocom™ Compatible
- Zenith™ Compatible
- Pioneer™ Compatible
- Oak™ Compatible

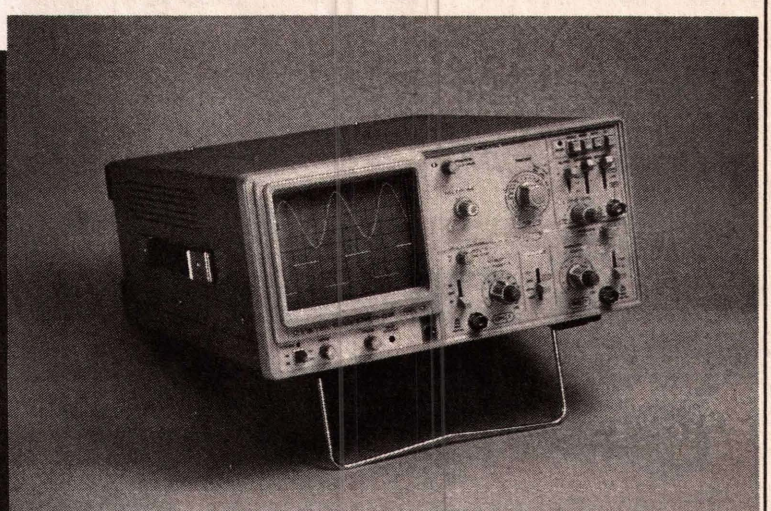
SATISFACTION GUARANTEED OR YOUR MONEY BACK!
BEST PRICES FREE CATALOG
Please have the MAKE & MODEL # of your full premium service cable box ready when you call!

ALLSTAR ELECTRONICS
800-782-7214
HOURS: 9-6 M-F 10-3 Sat EST

It is not the intent of Allstar Electronics to defraud any pay TV operator. Anyone implying theft of service will be denied assistance. All brand names are registered trademarks of their respective owners & are used for reference only. 110-64 Queens Blvd., #465, Forest Hills, NY 11375. NO NYS SALES!

INSTEK Test & Measuring Instruments

20 MHZ, 2-Channel, OSCILLOSCOPE
- model #OS-622B
- 20MHz, Dual Channel
- High Sensitivity 1mV/DIV
- TV Synchronization
- Z axis input
- ALT Triggering Function
- Hold Off Function
- Trigger Level Lock Function
- CH 1 Output
- Includes Probes (x1, x10)
- 2 Year Warranty



Regular $499.00 Sale $389.95

PRINT™ Products International

800-638-2020

Test Instruments, Equipment, Tools & Supplies For Electronic Production, Maintenance & Service
8931 Brookville Road, Silver Spring, MD, 20910 * 800-638-2020 * Fax 800-545-0058

CIRCLE 45 ON FREE INFORMATION CARD

SEE US NOW AT http://www.cir.com

CIRCUIT SPECIALISTS INC.

Check Out What We Have To Offer:

Fantastic DMM Offer!!!

Don't let the price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/RANGE selector rotary switch.

Rubber Boot Included

Our Best Offer Ever on a High Quality Full Sized DMM

General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

Range:	*Resolution:*	*Accuracy:*
200mV	100µV	±(1%rdg+2dgts)
2000mV	1mV	
20V	10mV	
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	*Resolution:*	*Accuracy:*
200µA	100nA	±(1.2%rdg+2dgts)
2000µA	1µA	
20mA	10µA	
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgts)

Overload Protection: mA Input. 2A/250V fuse.

AC Voltage (ACV)

Range:	*Resolution:*	*Accuracy:*
200V	100mV	±(1.2%rdg+10dgts)
750V	1V	

Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

Resistance (Ω)

Range:	*Resolution:*	*Accuracy:*
200Ω	100mΩ	±(1.2%rdg+2dgts)
2000Ω	1Ω	
20KΩ	10Ω	
200KΩ	100Ω	
2000KΩ	1KΩ	
20MΩ	10KΩ	±(2%rdg+10dgts)

Maximum Open Circuit Voltage: 2.8V

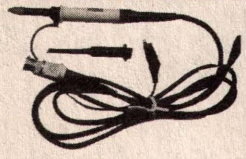
Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

hFE Test
Measures transistor hFE.

$19.00 any qty

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	$19.00

Switchable Scope Probe Sets



(Selectable X1/Ref/X10) These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

		PRICE EACH		
CAT NO	DESCRIPTION	1	10	100
HP-9060	Scope Probe Set DC~60MHz	$16.49	$14.49	$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

		PRICE EACH		
CAT NO	DESCRIPTION	1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 185mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

		PRICE EACH		
CAT NO	DESCRIPTION	1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 185mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80

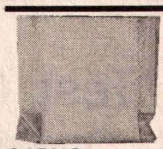
Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

		PRICE EACH		
CAT NO	DESCRIPTION	1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 185mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

Etching Chemicals/Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

		PRICE EACH	
CAT NO	DESCRIPTION	1	5
ER-3	Makes 1 pint	$3.50	$2.75



Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water,

		PRICE EACH		
CAT NO	DESCRIPTION	1	10	25
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching Tank This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

REDUCES ETCHING TIME!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

Desoldering Pumps

These powerful plastic body desoldering pumps are designed for easy one hand operation for fast, efficient desoldering. Double O-ring piston seals for maximum suction.

		PRICE EACH		
CAT NO	DESCRIPTION	1	5	10
08-366S	Large Desoldering Pump	$15.89	$13.49	$11.95
08-366E	Regular Desoldering Pump	10.89	8.59	7.39
08-366TIP	Replacement Tip	1.95	1.95	1.95

!!!!!!! SEE OUR ON-LINE CATALOG AT http://www.cir.com !!!!!!!

Electronic Soldering System

Here's the ideal solution when **Temperature Control** is required. Easy to use slide control allows user to set system from 300°F to 840°F. Voltage to iron from control unit is 24V Iron heating power is 48W. Replaceable 5.3mm tip is standard. Replacement irons and tips are available.

AS LOW AS $50.00

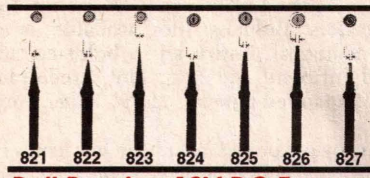
CAT NO	DESCRIPTION	PRICE EACH 1	5
SL10	Temp Controlled Soldering Iron	$56.00	$50.00
SL24V	Spare 24V Soldering Iron	10.50	7.50

Electronic Soldering System with LED Display

Deluxe temperature controlled system with LED display for maximum accuracy. Temperature is adjustable from 160°-480°C (320°-900°F). Iron heating power is 48 Watts. Runs on 24V from controller unit. Replacement irons and tips are available. Tip size is 5.3mm.

AS LOW AS $75

CAT NO	DESCRIPTION	PRICE EACH 1	5
SL30	Deluxe Soldering System w/LED	$86.00	$75.00
SL24V	Spare 24V Soldering Iron for SL10 or SL30	10.50	7.50

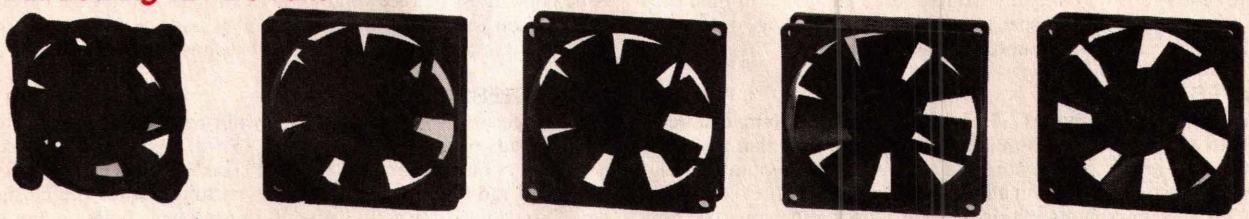


Replacement Tips for SL10/SL30

We now offer a variety of replacement tips for the SL10/SL30 soldering stations.

CAT NO	DESCRIPTION	PRICE EACH 1	5
821	1/32" Pencil Tip	$1.39	$1.19
822	1/32" Pencil Tip	1.39	1.19
823	1/64" Pencil Tip	1.39	1.19
824	1/16" Chisel Tip	1.49	1.29
825	1/8" Chisel Tip	$1.49	$1.29
826	3/64" Chisel Tip	1.49	1.29
827	3/64" Pencil Tip	1.59	1.39

Ball Bearing 12V DC Fans



These High Quality Fans feature Ball Bearings and Brushless DC Motors. All of them are designed to meet UL, CSA & VDE Standards. Design these fans into power supplies, computers or other equipment requiring additional air flows for heat removal. These fans are regular Circuit Specialists stock items — they are not surplus.

INDUSTRY BEST PRICING!

CAT NO	PRICE EACH 1	10	25	100
CSD 4010-12	$ 9.88	$ 6.38	$5.48	$4.87
CSD 6025-12	9.38	5.91	5.41	4.71
CSD 8025-12	8.88	5.85	5.19	4.49
CSD 9225-12	8.95	6.14	5.29	4.59
CSD 1225-12	11.45	8.96	7.82	6.85

Specifications

CAT NO	DIMENSIONS (MM)	RATED VOLTAGE (V)	START VOLTAGE (V)	INPUT CURRENT (A)	AIR FLOW (CFM)	STATIC PRESSURE ($INCH-H_2O$)	SPEED (RPM)	NOISE LEVEL (dB)	WEIGHT (g)
CSD 4010-12	40x40x10mm	12	7	0.06	5.1	0.19	5,500	26	20
CSD 6025-12	60x60x25mm	12	5	0.13	13.7	0.165	4,500	28	65
CSD 8025-12	80x80x25mm	12	5	0.16	37.8	0.177	3,000	31	80
CSD 9225-12	92x92x25mm	12	5	0.32	42	0.18	2,800	37	95
CSD 1225-12	120x120x25mm	12	5	0.35	62	0.180	2,500	42	135

• SOLDER • SOLDER • SOLDER •
• SOLDER • SOLDER • SOLDER •

We stock high quality 60/40(Sn%/Pb%), .031" and 63/37, .031" diameter. This is prime JIS certified solder that we maintain as a regular stock item (It is not "Left-overs, Rejects or Surplus") and you can buy it from us at a fraction of the price that you are used to.

Tired of Paying Inflated Prices for Solder?

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
RH60-1	1-lb. Spool, .031", 60/40	$ 6.90	$ 5.96	$ 5.30
RH63-1	1-lb. Spool, .031", 63/37	6.95	6.10	5.41
RH60-4	4.4-lb. Spool, .031", 60/40	24.00	21.90	17.92
RH60-TUBE	6-oz. Tube, .031", 60/40	.99	.89	.79

CCD Camera - IR Responsive

As Low As $109!!

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connectiong three wires: red to 12V, black to ground (power & video) and brown to video signal output.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$125.00	$109.00

!!!!!!! SEE OUR ON-LINE CATALOG AT http://www.cir.com !!!!!!!

CIRCUIT SPECIALISTS, INC.

SINCE 1971

800-811-5203
602-464-2485
602-464-5824(FAX)

WE ACCEPT: VISA MasterCard NOVUS

RECEIVE OUR LATEST 132 PAGE CATALOG!

It's chock full of all types of electronic equipment and supplies. We've got I.C.'s, capacitors, resistors, pots, inductors, test equipment, breadboarding supplies, PC supplies, industrial computers, data acquisition products, personal computers and computer parts, plus much, much more. FAX us your name and address or call **800-811-5203, ext. 5,** to leave a message on our catalog request line.

USE POPULAR ELECTRONICS

READ BY BUYERS OF ELECTRONIC EQUIPMENT ACCESSORIES AND PARTS

INSTRUCTIONS FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but, in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.75 per word. Minimum charge is $26.25 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Sorry, no discounts on credit-card orders. Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add $2.25 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. POPULAR ELECTRONICS is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in POPULAR ELECTRONICS is limited to electronics items only. All ads are subject to the publishers approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: $1.75 per word, Minimum $26.25

Send you ad payments to:
POPULAR ELECTRONICS 500 Bi-County Blvd, Farmingdale, NY 11735-3931

CATEGORIES

100 -- Antique Electronics
130 -- Audio-Video Lasers
160 -- Business Opportunities
190 -- Cable TV
210 -- CB-Scanners
270 -- Computer Equipment Wanted
300 -- Computer Hardware
330 -- Computer Software
360 -- Education
390 -- FAX
450 -- Ham Gear Wanted
480 -- Miscellaneous Electronics For Sale
510 -- Miscellaneous Electronics Wanted
540 -- Music & Accessories
570 -- Plans-Kits-Schematics
630 -- Repairs-Services
660 -- Satellite Equipment
690 -- Security
710 -- Telephone
720 -- Test Equipment

CLASSIFIED AD COPY ORDER FORM

Place this ad in Category #_____ **Special Category $20.00 Additional** _____

1 - $26.25	2 - $26.25	3 - $26.25	4 - $26.25
5 - $26.25	6 - $26.25	7 - $26.25	8 - $26.25
9 - $26.25	10 - $26.25	11 - $26.25	12 - $ 26.25
13 - $26.25	14 - $26.25	15 - $26.25	16 - $28.00
17 - $29.75	18 - $31.50	19 - $ 33.25	20 - $35.00
21 - $36.75	22 - $38.50	23 - $40.25	24 - $42.00
25 - $ 43.75	26 - $45.50	27 - $47.25	28 - $49.00

29 - $50.75	30 - $52.50	31 - $ 54.25	32 - $56.00
33 - $57.75	34 - $59.50	35 - $61.25	36 - $63.00
37 - $64.75	38 - $66.50	39 - $68.25	40- $70.00

Total words _____ $1.75 per word = $_____

Bold Face _____ $0.40 per word = $_____

Special Heading _____ $20.00 = $_____

Other_____ = $_____

Total classified ad payment $_____ **enclosed**

TOTAL COST OF AD $ _____

[ ] Check [ ] Mastercard [ ] Visa [ ] Discover Card # _____ Expiration Date __/__

Signature_____

Name _____ Phone _____

Address_____ City State Zip _____

ELECTRONIC KITS! VOICE CHANGERS! AND MORE!

ELECTRONIC KITS!

TOLL FREE ORDER LINE: 1-800-336-7389
FAX LINE: 1-602-731-4748
TECH SUPPORT NUMBER: 1-602-894-0992

BUY WITH CONFIDENCE FROM XANDI
30-DAY REFUND POLICY

143.775 MHz CRYSTAL CONTROLLED TRANSMITTER KITS

XTR300 $79.95
XTL3000 $89.95
XTL1000 $69.95

CRYSTAL TRANSMITTER KITS
- Ultra-miniature surface mount construction.
- E-Z kit approach makes assembly a snap.
- Miniature battery and holder mounted directly to the circuit board.
- Transmit to any scanner type receiver

XTR300
TRACKING TRANSMITTER KIT
Transmits continuous beep-beep-beep
Ideal for locating lost or stolen items
Range up to 1/2 mile

XTL3000
LONG RANGE TRANSMITTER KIT
Sensitive built in microphone
Range up to 1 mile
Custom frequencies available

XTL1000
TRANSMITTER KIT
Sensitive built in microphone
Range up to 1/2 mile
Custom frequencies available

BUG DETECTOR

XBD500
$149.95

- **Professional quality.**
- **Not a kit,** ready to use.
- Covers 1 to 2,000MHz.
- Uses new Microwave Integrated Circuit amplifier.
- Adjustable sensitivity.
- Audio jack for privacy ear phone.

Any intercepted signal causes an audio tone that increases from a low pitched growl to a high pitched squeal as the signal strength increases.

88-108 MHz FM RECEIVER

XMR2000
$29.95

- Worlds smallest FM radio.
- As small as a hearing aid.
- Weighs less than 1/4 oz.
- Digital touch tuning.
- Ideal for use with our 88-108MHz FM transmitters

88-108 MHz FM TRANSMITTER KITS

XST 500 $44.95
XWB 1000 $46.95
XFM 100 $21.95
XSP 250 $28.95
XTR 100 $29.95
XTT 100 $19.95

XST 500 Voice transmitter. Range up to 1 mile. Supersensitive mic. Uses 9 volt battery. Uses surface mount components.

XWB 1000 Voice transmitter. Range up to 1/2 mile. Includes mic and battery on circuit board. Uses surface mount components.

XFM 100 Voice transmitter. Range up to 1 mile. 9 v battery and leaded components.

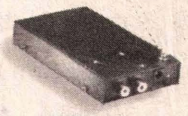
XSP 250 Super-miniature telephone transmitter. Range 1/4 mile. Powered by phone line. Uses surface mount component.

XTR 100 Tracking transmitter. Range up to 1 mile. Uses 9 volt battery. Transmits a BEEP - BEEP - BEEP tone

XTT 100 Telephone transmitter. Range up to 1 mile. Uses 9 volt battery.

XPC 400
TV CAMERA
400 LINES OF RES
- Use any TV or VCR with a video input connector.
- Includes power cube.
- About half the size of a pack of cigarettes.
- See entire room through pin sized hole.

Assembled $269.95



VS100
TV TRANSMITTER
- Use with XPC400, VCR, Camcorder, etc.
- Power cube included.
- Uses the UHF TV band.
- Transmits video and audio.
- Up to 100 foot range.

E-Z Kit $29.95

16 levels of digital voice changing. Sound tougher, older or younger, female or male. Both use modular phone jacks.

PHONE VOICE CHANGERS

Works with regular or multi-line phones. Connects between handset and phone

T-2001 $59.95

T-2000 $89.95

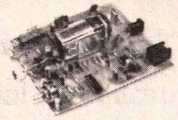
Use as regular or voice changing phone

XLB-9 $8.95
9V LITHIUM BATTERY
Worlds most powerful 9V battery! Twice the life of alkaline batteries.

XLB-3 $3.95
3V CAMERA BATTERY
Small 3V Lithium battery. For use with XTL3000, XTL1000, XTR300, and XWB1000.

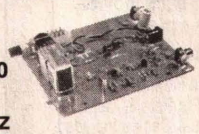
PROJECT BOX $13.95
Ideal project box to give your kits that professional look. Available custom drilled for the following kits: XFS108, XPS1000, and XLC900.

XANDI ADVANCED HOBBY KITS



XPS 1000 $55.95

TELEPHONE SNOOP KIT
- Dial home from anywhere and hear inside your home.
- TouchTone coded for secure operation.
- Stop burglars and intruders.
- Reliable 24 hour protection.



XLC 900 $49.95

800-950MHZ SCANNER CONVERTER KIT
- Uninterrupted coverage of the 800 to 950 MHz band!.
- Works with any 400-550MHz scanner.
- Gain: 6 dB typical.
- Noise figure: 3 dB typical.

XBD 200 $39.95

BUG DETECTOR KIT
- 1MHz thru 2000MHz frequency range.
- Uses super sensitive microwave transistor amplifier stage.
- Includes miniature speaker for audio indication of detected signals.
- Uses 9V battery. (Not included)

XFS 108 $39.95

88-108 MHz FM STEREO TRANSMITTER KIT
- Separate level control for both left and right channels.
- Output level circuit with test points for quick and easy tuning.
- Transmit from any stereo audio source to most any FM stereo receiver.

Serving the public since 1981
XANDI ELECTRONICS, INC.
1270 E Broadway Rd. # 113
Tempe AZ 85282

WE ACCEPT CHECK, VISA, MC, MO, COD SHIPPING & HANDLING EXTRA

Master Card VISA

SEND $2.00 FOR COMPLETE CATALOG REFUNDABLE ON FIRST ORDER

SEND MAIL ORDERS TO:
XANDI ELECTRONICS
BOX 25647
TEMPE, AZ 85285-5647

CIRCLE 134 ON FREE INFORMATION CARD

New Surveillance Devices!

Smoke Alarm and Table Clock Video Cameras — Ultra miniature video cameras hidden in smoke alarm or alarm clock - your choice. Wide field of view and super .1 lux low light sensitivity! Undetectable!

SC-600 *TC-70* High quality B/W with 420 lines of resolution for ultra sharp images. Direct output of video and audio. $219.95 ea.

Best price on surveillance cameras anywhere!

Telephone Transmitter Kit hidden in dual modular adaptor Transmits both sides of conversation to any FM radio up to 1/4 mile."SnapKit" technology. Uses phone line for power and antenna! Goes completely unnoticed. *MA-100* $25.95

THR-12 12 Hour Telephone Recorder $99.95 High quality cassette deck plugs directly into telephone jack! Records up to 12 hours of conversations on a single cassette. Recording starts and stops automatically when phone is used! Visa/MC (214)255-7490

Free shipping! Check/Money orders also accepted

Seymor-Radix Inc. Box 166055-E Irving,TX 75016

Now you can visit us on the internet at http://www.why.net/home/sr/

SURVEILLANCE

The Latest High Tech Professional Electronic Devices

Our latest catalog offers a **HUGE** selection of surveillance, privacy devices including: hidden video equipment, electronic kits, telephone recording systems, touch tone decoders, scanners, telephone tap detectors, bug detectors, voice disguisers, telephone scramblers,locksmithing tools, and more. **Catalog $5.00.**

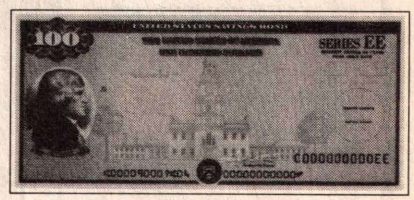
SPY OUTLET

P.O. Box 337, Buffalo, NY 14226

(716) 691-3476/(716) 695-8660

Education? Retirement? Peace of Mind?

You have your reasons.



No matter what you're saving money for, U.S. Savings Bonds make sense. They're backed by the full faith and credit of the United States. They earn interest for up to 30 years. And their value is guaranteed to grow at market-based rates.

Ask your employer or banker about saving with U.S. Savings Bonds.

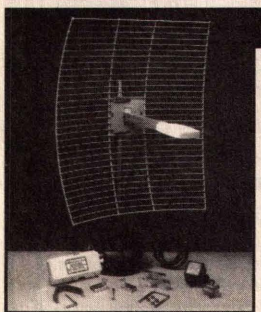
Or for a recorded message of current rate information, call 1-800-4US-BOND

1-800-487-2663

Take Stock in America — U.S. SAVINGS BONDS

A public service of this magazine

Quality Microwave TV Systems



WIRELESS CABLE - ITFS - MMDS

ATV - INTERNATIONAL - S-BAND

Amplifiers • Antennas • Books • Components

Filters • Systems • Video Products

- RF Frequency 1990 - 2700 MHz
- Cable Ready - VHF - UHF Outputs
- SASE For "FREE" Catalog or Send $1

PHILLIPS-TECH ELECTRONICS

PO Box 8533 • Scottsdale, AZ 85252

CHALLENGER SYSTEM
33-Channel 52dB+ Gain
Complete Grid $265
Five Year Warranty
FREE SHIPPING

ORDER LINE 800-880-MMDS
CATALOG / INFO 602-947-7700
FAX LINE 602-947-7799
Visa • M/C • Amx • Disc • COD's • Qty Pricing

CIRCLE 149 ON FREE INFORMATION CARD

Radiotelephone - Radiotelegraph

FCC Commercial License

Why Take Chances?

Discover how easy it is to pass the exams. Study with the most current materials available. Our **Homestudy** Guides, Audio, Video or PC "Q&A" pools make it so fast, easy and inexpensive. No college or experience needed. The new commercial FCC exams have been revised, covering updated Aviation, Marine, Radar, Microwave, New Rules & Regs, Digital Circuitry & more.We feature the Popular "Complete Electronic Career Guide" 1000's of satisfied customers **Guarantee** to pass or money back. Send for **FREE DETAILS** or call

1-800-800-7588

WPT Publications
4701 N.E. 47th Street
Vancouver, WA 98661

Name_____

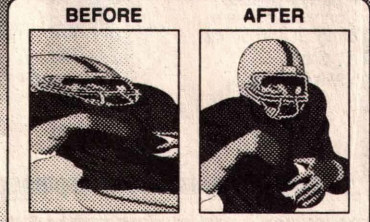
Address_____

City_____St._____Zip_____

1-800-800-7588

IMPROVE YOUR IMAGE!

WITH OUR VIDEO STABILIZERS



SUPER VHS MODEL AVAILABLE!

The clearest picture possible playing back movies. GUARANTE to eliminate copy protection.

- No Rolls/Jitters/Flickers/Fading
- Works on all TV's, VCR's Beta & Cable
- Gold Video Connectors & Cables Included
- 2 Year Warranty
- Money Back Guarantee

VISA MasterCard DISCOVER

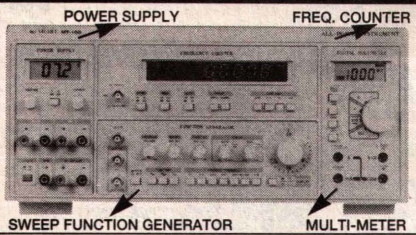
VISION ELECTRONICS

1-800-562-2252

2125 S. 156TH CIRCLE • OMAHA, NE 68130

Unbeatable Discount Prices

1 YEAR WARRANTY
15 DAY MONEY BACK GUARANTEE



MT-100

Reg. $599.

$419.00

Four Instruments in One Instrument

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.2 Hz ~ 2MHz

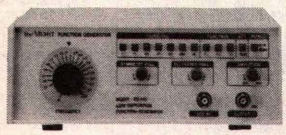
2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

4 Digital Multimeter
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

FG-140 2MHz Function Generator

Reg. $249. **$149.00**



- 0.2 Hz ~ 2.0 MHz, 7 Decades
- Sine, Square, Triangle, Pulse, Ramp, Skewed Sine
- VCF, Symmetry
- Variable DC Offset Control

2MHz Sweep Function Gen. w/Freq. Counter

FG-150

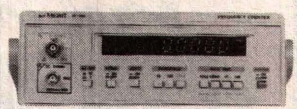
Reg. $399. **$229.00**

- 4 Digit LED Display
- Sine, Square, Triangle, TTL, Pulse, Ramp, Skewed Sine
- Linear/Logarithmic Sweep
- 10 MHz Freq. Counter

1.0GHz Frequency Counter, High Resolution

FC-200

Reg. $399. **$219.00**



- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- 4 Selectable Gate Times
- 1MΩ & 50Ω Input Impedance

Oscilloscope Probe Set

Switch Selectable X1/X10

HP-9060, 60MHz *Reg. $29.* **$17.00**

HP-9150, 150MHz *Reg. $49.* **$27.00**

HP-9250, 250MHz *Reg. $59.* **$37.00**

PS-500 DC Power Supply

Reg. $249. **$159.00**

- 0-30 VDC
- 0.1 ~ 3A
- Short & Overload Protection

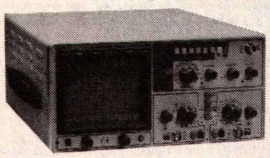
PS-540 DC Power Supply

Reg. $399. **$249.00**

- 0-16 VDC
- 0.1 ~ 10A
- Short & Overload Protection

Deluxe O'scopes w/Phillips CRT. "BEST BUY!"

OS-3304 *Reg. $499.* $349.00



OS-3324 *Reg. $599.* $429.00

OS-3344 *Reg. $899.* $649.00

OS-3304 25MHz, Dual Trace

1 • DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

OS-3324, 3 Function

1 • OS-3304

2 • Dual Component Tester/Comparator

3 • Triple DC Power Supply 5VDC, +12 VDC, -12VDC

OS-3344, 5 Function

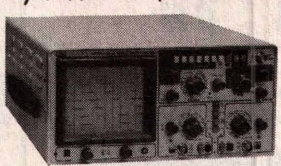
1 + 2 + 3 • OS-3324

4 • Frequency Counter 100MHz, 7 Digit LED Display

5 • Function Generator 0.02 Hz to 2.0 MHz

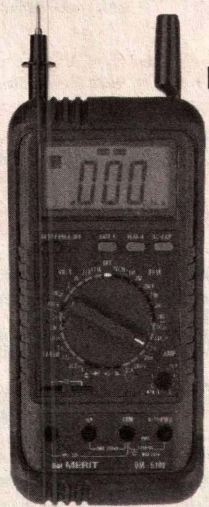
OS-3315 40MHz, Dual Trace Sweep Delayed

Reg. $799. **$549.00**



- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1.OS 7 decade
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
- 60MHz (X1.X10) Probe Kit: 2 sets
- Power: 115/230V AC

Bel MERIT DM5050C DM5100



Reg. $149.

$89.00

Including Deluxe Holster

Features (DM5050C/DM5100)
- Basic DCV Accuracy: ± 0.25%
- AC/DC Volt & Amp, Ohm
- Diode, Continuity Beeper
- Alligator Clip Test-Leads
- Lead Holders/Velcro Strap Holster

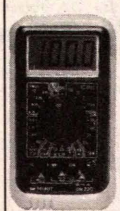
DM5050C, DMM + Capacitance
- 9 Function / 42 Range
- Multimeter
  - Ohm: Up to **2000MΩ**
  - Amp: AC/DC 2 Amp
- Extended Capacitance Meter (9 Range)
  - **0.1pF - 20,000µF**
  - Zero Adjust Knob
- Trig Lamp

DM5100, Wide Range w/Logic
- 11 Function / 45 Range
- Auto Power Off
- Data Hold & Peak Hold
- Freq: Up to **20MHz**
- Amp: Up to **20A AC/DC**
- Ohm: Up to **200MΩ**
- Capacitance: **1p - 200µF**
- Logic: TTL, TR hFE

Digital Engine Analyzer

Reg. $119. **$69.00**

DM230



- 3 1/2 Digit LCD
- **Engine Analyzer** Taco, Dwell, Duty Cycle
- **DMM** DCV, DCA, Ω
- **Temperature** 0 ~ 1.999°F
- Diode
- Continuity
- Holster, Temp. Probe, Clip Leads

Capacitance Meter

Reg. $79. **$49.00**

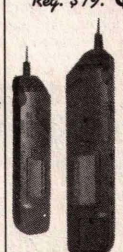
CM210

- 3 1/2 Digit LCD
- 0.1p-20,000µF 9 Ranges
- 0.5% basic Accu.
- Zero Adjust Knob
- Test Leads & Built in Socket

Pen-Type DMM w/Logic

Reg. $79. **$59.00**

DM150



- 3 1/2 Digit
- Dual Display
- Auto & Manual
- DCV, ACV, ACA, DCA, Ω
- Logic CMOS/TTL
- Data Hold
- Diode
- Continuity

Multifunction DMM

Reg. $99. **$64.00**

DM4050

- 3 1/2 Digit
- Basic Accuracy: 0.25%
- Heavy Duty, 20A AC/DC Resistance 20MΩ
- Capacitance
- Freq. up to 20MHz
- TR-hFE
- Diode
- Continuity
- Deluxe Holster

BMC *Your Best Source for High Standard Electronics*

P.O. Box 744, Lake Forest, CA 92630-0744

Order & Free Catalog

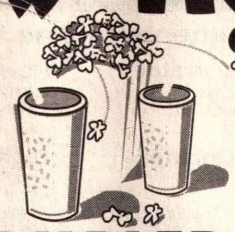
800-532-3221

(714) 586-2310 Fax (714) 586-3399

VISA MasterCard

CIRCLE 30 ON FREE INFORMATION CARD

SHOW TIME CABLE



The Best in Cable CONVERTERS & DESCRAMBLERS

Take a LOOK at the exciting new

Prelude!

Just $339!

We work hard to be the Low Cost Leader! Shop the rest, then call us to compare. We guarantee you, no other reputable firm can beat our prices!

COD • Master Card • Visa • Amex • Discover

Show Time Cable • 643 N. 98th Street, Ste. 260 • Omaha, NE 68114

Your Low Price Leader!

Order By Phone, Fax, or Mail

800-643-4258

CONTROL

RELAYS • LIGHTS • MOTORS

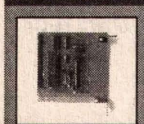
MEASURE

TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY

INPUT

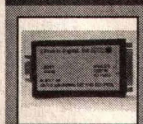
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 ..... $79



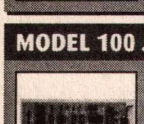
- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL-8 BIT A/D/ IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 45 ..... $189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 ..... $279

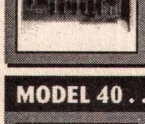


- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 60 ..... $179

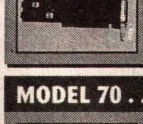
- 8 2-AMP RELAYS
- 16 DIGITAL I/O
- 1 8-BIT ANALOG INPUT

MODEL 40 ..... $99



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT
- OPTIONAL 12 BIT A/D

MODEL 70 ..... $239



- RS-232 INTERFACE
- 16 BIT A/D
- 5.5 DIGIT
- UP TO 60 SMP/SEC

NEED A CUSTOM PCB? TRY US.

PRAIRIE DIGITAL, INC.

PHONE 608-643-8599 • FAX 608-643-6754

846 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

TOP SECRET

CONSUMERTRONICS
2011 Crescent Dr., P.O. Drawer 537
Alamogordo, NM 88310
- - - Please order by Mail or Fax only - - -

Fax: (505)434-0234, 439-1776 (orders only; if you get voice, enter *#11#11 any time), 24-hr

Customer Service & Tech Support:
(505)439-8551 (8AM-6PM MST, Mon-Sat)
Relates directly to your order or prospective order.

Web Site: Visit our popular site (tell your friends) at: http://users.aol.com/wizguru/hi-tech.html

10% Off on orders $100+ 15% Off over $200+
Add $5 total S/H (US, Canada). All items in stock. Postal M.O. is fastest. VISA, MC CC OK. COD ($49-$999), add $8. New Catalog (200+ offers) $2 w/ order, $5 w/o (no CC), $24/foreign. NO dealers.

Since 1971. As seen on CBS *60 Minutes,* Forbes, etc. By John Williams - former Lockheed Senior Engineer, NMSU CS Professor, DOD Electronic Weapons Engineer, NIH Health Physicist. Sold for educational purposes only.

Wanted: 5 MAC IIfx, PC486 (or better), peripherals, new surplus electronic parts, test equipment - buy, trade. *All software supports all IBM-PC systems.

Off-the-Shelf HARDWARE

Van Eck Systems★Data Card Reader/Writers★ATM3★Security/Surveillance★RF/EM/µWave/Radar/Ultrasonic/IR/Light/Sound Detectors/Receivers/Xmitters/Jammers/Blasters★Neurophone/Rife/Hieronymus/Resonant Crystal Radionics★ EM Lab/Weaponry/Countermeasures★ESS Infinity Devices★Voice Disguisers★Lineman's Hand-sets★Bug/Tap Detector/Blaster★Phone Color Boxes★DTMF Decoders★Carjack/Kidnap Foiler★Bumper Beeper/Child Finder★Panic Button★Shriek Module★TENS★Subliminal Mixer/Amp (Ultrasound & Infrasound)★Electronic Dowsers★Hidden Presence Detectors★Hearing Assistor★Vortex Generator★6th Sense Communicator★Noise Cancel. System★Levitator - many more! See our New Catalog!

SPECIAL PROJECTS

We design/build/obtain/repair/modify/maintain/consult on any device/system/process/project - electronic/computer/mechanical/optical (ex: phone/auto/security/radionic/lab/energy/HV/EM/RF/radar/ultrasonic/IR/UV/commo/consumer) for business/personal/invention needs. Describe & include $30 pre-engineering fee (no obligation). Time & cost estimates 7-10 days. Confidentiality guaranteed.

CELLPHONE MODS

See our Catalog for our infamous cellphone modification guide ($69) - detailed, comprehensive, covers all makes - 10 times more info than competitor's "guide"). (Do Special Projects above to get up-to-date hardware/software).

Free Data Search: As a special FREE service to our C&CP customers, we will perform one FREE search of our massive cellphone database if requested within 30 days of your purchase of C&CP. Data now on cellphones is so great, we can fit in C&CP only that in greatest demand. Search results not guaranteed. Request by mail (don't fax); include a #10 SASE.

PAGER (Beeper) MANUAL

Describes in detail how Pagers work, different types and uses, frequencies, advantages over and uses with cellphones, and tips and tricks. And how Pagers are hacked and countermeasures. Includes the plans for your own Personal Pocket Paging System (transmitter and receiver). $49.

HACKING FAX MACHINES

Describes in detail how Fax machines are hacked and countermeasures (hacking Faxes is much more complex than just connecting a third Fax to the phone line). Includes Fax protocols, commo parameters, and 2:1 and 4:1 compression. And insights into designing Fax interception devices and modifying existing Faxes into Stealth Faxes do the job. $49.

VOICE MAIL HACKING

How Voice Mail Box (VMB) systems are used and the specific ways they are hacked. Includes ASPEN, MESSAGE CENTER, BIX, GENESIS, EZ, SYDNEY, PHONE MAIL, AUDIX, CINDY, CENTAGRAM, SPERRY LINK, RSVP, etc. Absolutely required for all users, sysops and security personnel! $29.

PBX HACKING

1,000s of PBXs are hacked to the tune of $ Billions/yr! While *VOICE MAIL HACKING* details how VMSs are hacked for *phun* and profit - including VMS methods for hacking PBXs themselves - *PBX HACKING* addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a $90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in Forbes Magazine. $29

PHREAKING CALLER ID & ANI

Details on how they work and dozens of effective ways of defeating Caller ID, ANI, *69, *57, and Call Blocking and *67. Also describes Caller ID, Orange, Beige, Cheese and CF Boxes, ESS, SS7, E-911, various CLASS services, CNA, NON PUB DA, CAMA, DNR, 800-ECR, Diverters, Extenders, Centrex - more. $29.

COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS, etc are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system (Ed. Choice, PC Magazine). BBS advice, password defeats, glossary - much more! Manual + Disks* $39.

Beyond PHONE COLOR BOXES

Dozens phone color boxes described - many circuits. Plus Call Forwarding, Conferencing, Phreak History, Glossary, Diverters, Extenders, Loops, REMOBS, Bridging Heads & Cans, Optocom, 3rd Party and many other non-box methods - more. $39.

HACKING ANSWERING MACHINES

How answering machines are hacked to listen to - even erase - messages, and to convert them into mini-VMBs. And countermeasures - protect yourself from snoops, stalkers, burglers and pranksters! $29.

CREDIT CARD SCAMS

Cardholders, merchants, banks suffer $ Billions in losses annually because of credit card fraud. Describes every known means of credit card fraud and scams. Protect yourself! $29.

AUTOMATIC TELLER MACHINES

ATM crimes, abuses, vulnerabilities and defeats exposed! 100+ methods detailed, include: Physical, Reg. E, cipher, PIN compromise, card counterfeiting, magnetic stripe, false front, TEMPEST, Van Eck, tapping, spoofing, inside job, super-cool, vibration, pulse, high voltage - others. Case histories, law, countermeasures, detailed security checklist, labeled internal photos, figures. ATMs contain up to $250,000 in cash! Recent $350,000 ATM crime spree still unsolved! $39.

CONS, SCAMS & SWINDLES

Cons & scams and related swindles fleece Americans of $100+ Billion per year! The most comprehensive survival manual on cons & scams of all kinds - from the classic to hi-tech. Details on 100s and many variations. And countermeasures. Protect yourself! $39.

INTERNET CONS & SCAMS

Internet cons, scams and related frauds now rake in $2+ Billion annually! Most are done anonymously and with little fear of prosecution (difficult to prove and to find the perpetrators). Described in detail, includes countermeasures. $29.

Beyond VAN ECK PHREAKING

Eavesdropping on TV and computer video signals using an ordinary TV described in detail. Includes security industry reports. Range up to 1 KM. Plans include both the Consumertronics and the original Top Secret Van Eck designs! $29.

The HACKER FILES

Compilation of 100s of the best articles written (in ASCII) by top hackers & phreakers. Covers every major topic in hackerdom! 3 HD Disks* $59.

STOPPING POWER METERS

As reported on CBS *60 Minutes*: How certain devices can slow down - even stop - watthour meters - while loads draw full power! Device simply plugs into one outlet and normal loads into other outlets. Also describes meter creep, overload droop, etc. Plans $29.

I.Q. MANUAL: External magnetic ways (applied to the meter itself) to slow down and stop watthour meters while drawing full loads. Plans. $25. KW-HR METERS: How watthour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. $25. Any 2, $47. All 3, $69.

UNDER ATTACK!

Electromagnetic Interference and Electronic Weapon Attacks cause: Cancer, birth defects, and profound psychological, neurological, cardiovascular and immune system disorders! Destructive to people, animals, plants, equipment! Includes ACTUAL CASES OF EM ATTACKS (we investigated)! Includes how to verify and pinpoint EMI and electronic attack sources, and effective countermeasures. $29. EM BRAINBLASTER: Tutorial and plans for powerful ELECTROMAGNETIC WEAPONS and LAB DEVICES. Optimum circuits, freqs, waveforms, duty cycles, intensities. Thorough. $29. Both $49.

MIND CONTROL

Concern and fear increases over EM and ultrasonic mind (and body) control technologies - especially implants! Unfortunately, there is much more misinformation and disinformation published than facts. Some victims are controlled and exploited by arm-chair *experts* and so-called victims' assistance groups - one even demands the policing of the Internet to prevent and remove postings it doesn't approve of! $39. Visit our site at: http://users.aol.com/wizguru/mindcontrol.html

RADIONICS MANUAL

Exciting electrical, electronic, electromagnetic therapeutic, diagnostic & preventive devices (mostly experimental). History, descriptions, plans (dozens), availabilities of Radionics Devices from early to modern. While drugs cost $100s, electricity costs pennies! $29. HEAL THYSELF: Plans for 3 major electronic therapeutic devices of types approved by FDA. $19. Both $39.

HIGH VOLTAGE DEVICES

HV devices plans: Stun Gun, Taser, Prod, Cane, Blaster, Flasher, Zapper, Audio/RF/Radar Jammer, Fence Charger, Plasma & Van de Graaff Gens., Jacob's Ladder, Geiger Counter, Ozone Gen., Fish Stunner, Plant Stim., Kirlian, more! All plans for only $29.

STEALTH TECHNOLOGY

Police radar is fascinating! It also has error rates of 10-20%! Every known error mode - stealth method and material used to minimize radar reflections - tactic and strategy to fight unjust radar tickets (that cost you $100s in insurance and risk cancellation) - methods to detect and jam signals - fully described! $29.

SECRET & SURVIVAL RADIO

Optimum survival and security radio equipment, methods, freq allocations and voice/data scrambling/encoding. Includes small receivers/transmitters, telemetry, antenna optimizations, remote monitoring and control, security, surveillance, and ultrasonic, fiber-optic and infrared commo. 70+ circuit plans, tables. $29.

CRYPTANALYSIS TECHNIQUES

Five powerful menu-driven crypto programs (in .COM and .BAS source code) to analyze, decrypt *secure* ciphertexts. Worked-out examples. Recommended by prestigious *Computers & Security.* Manual+Disk* $29.

CIRCLE 47 ON FREE INFORMATION CARD

ALL ELECTRONICS CORPORATION

QUALITY PARTS

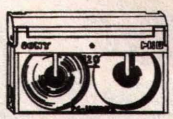
FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX or E-MAIL For A Free 64 Page CATALOG.
Outside the U.S.A. send $2.00 postage.

"HI-8" VIDEO CASSETTE (USED)

ATTENTION CAMCORDER USERS!



SONY Hi-8
Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box. Satisfaction Guaranteed.

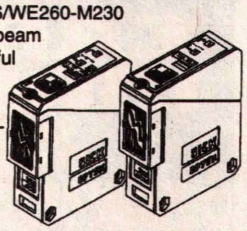
$3.00 each

CAT # VCU-8

10 for $28.00 • 100 for $250.00

RANGE 20 METERS (65.6 FEET) INDOOR/OUTDOOR PHOTOELECTRIC SWITCH

SICK Optex # WS/WE260-M230
Invisible infrared beam and switch is useful for a variety of security, safety and sensing applications such as perimeter alarms, electric gate or garage door controls or conveyor line sensing. Modulated beam covers a 20 meter distance even with poor visibility. IP-66 enclosure rating makes it dust proof and splash resistant, suitable for most outdoor conditions. Light/dark switching selector. Sensitivity adjustment control. LED power and sense indicators. Two position cable entry gland (90 deg. apart) accepts 1/2" threaded conduit and a variety of wire sizes. Glass fiber-reinforced plastic housings are 3.05" x 2.5" x 1". Supply voltage: 22-240 Vac. Solid State Output: 0.5 amp (must have load to operate). Includes mounting brackets and hardware. UL and CSA listed.



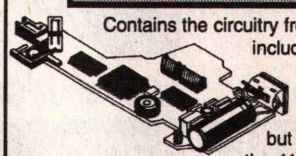
CAT # PES-4 ***NEW LOWER PRICE!*** **$35.00 each**

MAGNETIC CARD READER

Magtek# 21045002
Credit card or ID card magnetic strip reader consists of break-resistant plastic card guide with decoder pc board and head. Head is mounted on spring steel strip which keeps it pressed against the card surface. Terminated with a socket connector at the end of 5 color-coded leads.
3.57" X 0.9" X0.95"

CAT# MCR-2 **$6.00 each**

FLASH ASSEMBLY



Contains the circuitry from a camera including the flash assembly. We have no hook-up information, but we're sure that the 410 uf, 300 volt photo-flash capacitor, flash tube and trigger transformer are worth the price. 4.5" X 2.7" X 0.8" h.

$2.00 each **CAT# FSH-4**

10 for $15.00

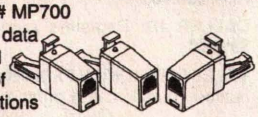
ULTRA-BRIGHT LED

Rohm # SLA-580MT-E49 T-1 3/4
GREEN, water clear in off state. 500+ mcd @ 2.1 v, 16ma.
CAT# LED-33 **2 for $1.00**

100 for $40.00 • 1000 for $300.00

FAX/MODEM LINE PROTECTOR

Ora Electronics # MP700
Protects against data interruptions and eavesdropping of private conversations when fax machine, modem or phone shares a line with other similar devices. Easy to install. Plugs inline between wall jack and telephone line. Requires one for each instrument sharing the same line.



$3.00 per package of 3 devices **CAT # MP-700**

THERMOELECTRIC COOLER PELTIER JUNCTIONS

NEW LOWER PRICING

These incredible miniature solid state heat pumps raise or lower temperature in a small area almost instantly. Utilizing the Peltier effect these modules perform the same cooling or heating functions as freon based refrigerators but they do it with no moving parts, and are very reliable. Current applied to the device will produce heat on one side and cold on the other side, up to 68° C difference between the two sides. Modules can be mounted in parallel to increase the heat transfer effect or can be stacked to achieve high differential temperatures. 127 thermocouples per device. Operates on 3-12 Vdc. Requires a heatsink to prevent overheating.

Two sizes available.

1.18" (30 mm) square
X 0.15" (3.8 mm) thick.

$17.00 each **CAT# PJT-1**
5 for $75.00

1.57" (40 mm) square
X 0.15" (3.8 mm) thick.

$26.00 each **CAT# PJT-2**
5 for $110.00

Quantity Pricing Available!

SPECIAL SALE! METAL OXIDE VARISTOR

Harris / GE # V130LA20B or equivalent
130 Vac nom. 70 Joules .
Peak pulse current: 6,500 amps.

$1.00 each **CAT# MOV-130-20**

100 for $75.00

ORDER TOLL FREE 1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
http://www.allcorp.com/
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D • Shipping and Handling $5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

CIRCLE 28 ON FREE INFORMATION CARD

BE AN ELECTRICIAN!

Home study. Maintain and install electrical systems, wiring, utilities, phones, and more.

FREE LITERATURE: 800-223-4542

Name _____ Age ____

Address _____ Phone ( )_____

City/State _____ Zip ____

The Electrician School, PCDI, DEPT TEK341
6065 Roswell Road, Atlanta, Georgia 30328

BUGGED??

EAVESDROPPING is unbelievably widespread! Electronic Devices with amazing capabilities can be monitoring your telephone and room conversations RIGHT NOW! Are you sure you're safe? **FREE CATALOG** tells you fast! Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and EXTREMELY profitable (up to $250 hr) full/part-time income. Call Now! 1-800-732-5000

Many Electronics inc

RFT,FTG,PIO-Supers,
Filters,FTG KIT's
800- 716-3561 9-7est

PUT YOUR PC TO WORK

THIS IS THE DREAM MACHINE YOU'VE BEEN WAITING FOR

2.5, 3, & 4 AXIS CNC/DNC
DESKTOP MANUFACTURING UNITS

STARTING AT $495.00

FREE CAD/CAM SOFTWARE

- AUTOMATICALLY PROTOTYPE PC BOARDS & MACHINE 3D PARTS FROM CAD
- CARVE, ROUTE, MILL, & DRILL WOOD, PLASTICS, & LIGHT METALS
- FREE POWERFUL 3D CAD/CAM SOFTWARE WITH EACH UNIT
- INEXPENSIVE CNC KITS AND ASSEMBLED CNC UNITS
- NOW OVER 20 DIFFERENT MODEL-OPTIONS
- EXPEDITE & SUPER-EXPEDITE AVAILABLE

SIZES FROM 12"x 12"
TO HUGE 6'x 6' UNITS

ORDER NOW! 501-839-8293 U.S. CYBERLAB, INC., 14786 SLATE GAP ROAD, WEST FORK, AR 72774

CALL NOW FOR INSTANT SPECS 501-839-8293 24 HR. FAX-BACK SERVICE

How would you like to work from your home in your underwear?

You could if you were one of the 25 million Americans who are now working out of their homes. Get the real scoop on the work-at-home market from two FREE cassettes recorded by George and Jeanie Douglass.

They started a $50 million-a-year business from the basement of their home and they have already helped couples and individuals of all ages start their own home-based businesses. Find out how they can help you too!

To receive FREE explanation cassettes and color literature:

Call toll free:

1-800-343-8014, ext. 3215

Computer Business Services, Inc.
CBSI Plaza, Ste. 3215, Sheridan, IN 46069

SURVEILLANCE

FM TRANSMITTERS MINI (KITS)
- 3-VOLT FM XMTR, up to 300 ft. indoors, 1500 ft. outdoors
- PHONE XMTR, range to 500 ft., uses phone-line power
- Sound-Activated XMTR, range to 500 ft.
- 2-STAGE XMTR, 9-Volt, very powerful

All above require simple soldering at 2 to 4 places. **$29.95** ea.**

TELE FM WIRELESS MONITORING SYSTEM. (Kit) **$99.00***

TELE CALL FORWARDER. Transfers incoming calls. **$99.00***

CALLER ID. Registers incoming number. **$99.00***

TEL REGISTER WITH PRINTER. Records dialed number, duration, and prints record. **$139.00***

12-HOUR LONG-PLAY RECORDER. Modified Panasonic. Records 6 hrs. on each side of 120 tape (supplied). Compatible with VOX and Tel Rec Adapter. **$119.00***

VOX VOICE-ACTIVATED SWITCH. Makes recorder self-activating with voices or other sounds. **$28.50****

TELE RECORDING ADAPTER. Records incoming and outgoing calls. **$28.50****

TELEPHONE SCRAMBLERS. Over 4,000 separate codes. **$199.00***

VOICE CHANGER. Changes man's voice to lady's and vice versa. **$49.00***

For Shipping & Handling add *$5.00 and **$2.00 per item. Colo. residents add sales tax. Mail Order, VISA, M/C, COD's o.k. Inquire for dealer prices. Free catalog.

MUCH, MUCH MORE — OUR 25TH YEAR!

TOLL FREE 1-800-926-2488

A.M.C. SALES, INC.
193 Vaquero Dr., Boulder, CO 80303
Tel: (303) 499-5405, Fax: (303) 494-4924
Mon.-Fri. 8 a.m.-5 p.m. Mtn. Time

CABLE DIRECT

CONVERTERS
DESCRAMBLERS
VIDEO STABILIZERS
FILTERS

100% MONEY BACK GUARANTEE!

30 DAY FREE TRIAL!

***FREE* Cable TV Catalog.**

VISA MasterCard DISCOVER

Now you can tune-in your favorite cable TV programming and
SAVE $100'S - EVEN $1000'S
on premium **CABLE TV EQUIPMENT.**

MODERN ELECTRONICS

1-800-906-6664

2125 S. 156TH CIRCLE • OMAHA, NE 68130

CIRCLE 39 ON FREE INFORMATION CARD

COUNTERSURVEILLANCE EQUIPMENT

AI 6600
PHONE TAP DETECTOR

DETECTS:
- Radio Frequency Taps
- Series and Parallel Taps
- Line Impedance Taps
- Extension Phone Listeners

$149.95

AI 2100
VIBRATING TRANSMITTER DETECTOR

DETECTS:
- Body Wires
- FM Wireless Mics
- AM Transmitters
- UHF Transmitters

$189.95

AI 5500
COMPLETE SAFETY SYSTEM

DETECTS:
- All Phone Taps and Extension Phone Listeners
- All Body Wires, Wireless Mics, AM/FM and UHF Transmitters

DEFEATS:
- All Body Wires, Transmitters and Distance Microphones with its built-in white noise generator

$379.95

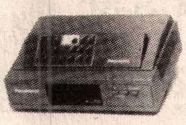
We also sell audio & video transmitters, body armor, covert cameras, night vision products, recording devices, tape recorder & video detectors, and much, much more...

Request Our 36-Page Catalog for $5.00, Receive $10.00 OFF First Order
(FREE WITH ANY PURCHASE)

AMERICAN INNOVATIONS, INC.
119 ROCKLAND CENTER ~ SUITE 315 • NANUET, NY 10954
VOICE: (914) 735-6127 • FAX: (914) 735-3560
HTTP://WWW.SPYSITE.COM • E-MAIL: WEBMASTER@SPYSITE.COM

CABLE T.V. EQUIPMENT

Friendly, Knowledgeable Service



ORDERS CALL:
1-800-361-4586

- All Equipment New
- Convertors & Descramblers
- 30 Day Money Back Guarentee
- 6 Month Warranty
- Visa, MC, C.O.D. Welcome

KDE ELECTRONICS, INC.
P.O. Box 1494
Addison, IL 60101
Info. **708-889-0281** HRS: Mon-Fri, 9-6 CST
Fax **708-889-0283** Sat, 9-3 CST

AMAZING ELECTRONIC & SCIENTIFIC DEVICES

Lasers, Tesla, Ions, Anti-Gravity, Magnetics & More!

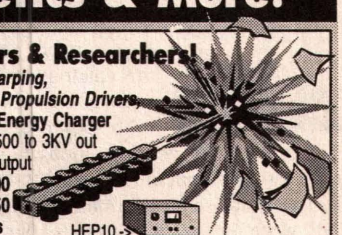
Laser Ray Gun
Handheld, battery operated. Produces an intense burst of light capable of burning holes.
LAGUN2 Plans $20.00
LAGUN2K Kit / Plans ..... Price on Req

250KV Tesla Coil
10-14" of Explosive Bolts of Lightning!

- Transmit Wireless Energy
- Ion Motors
- Anti-Gravity
- Strange and bizarre pyrotechnical effects
- Many other experiments shown in detail
- ***Award winning science project!***

BTC3 Plans $15.00
BTC3K Kit/Plans with coil $299.50
BTC30 Assbld Ready to Use $399.50
BTC4 Plans, 500KV unit $20.00

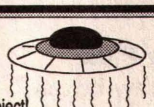
ATTENTION: Experimenters & Researchers!
Anti-Gravity, Rail & Coil Guns, Mass Warping, Levitation Research, Exploding Water, Propulsion Drivers, Lattice Snapping, EMP etc. **Loss-less Energy Charger** with triggered spark switch. • Adjustable 500 to 3KV out • Charges up to 25KJ • Programmable Output
HEP1 Plans $15.00
HEP1K Kit/Plans with 500J $399.50
HEP10 Lab Assembled - to your spec's
--- ..... Price on Req



Visible Beam Gas Lasers
Millions degree temp equiv. Illuminates low level clouds
- Light Shows
- Window Listener
- Optical Projects
- 12/115V
- Science Project

LAS1KM 1 mw, low cost Kit $69.50
LGU6K 2-3mw Kit $119.50
HNE70 5-7mw, ready to use $299.50

Gravity Generator
Levitate an object! Great science fair project!



GRA1 Plans $15.00
GRA1K Power Supply Kit/Plans ... $99.50
GRA10 Assbld Kit/Plans $149.50
Includes text book on Anti-Gravity theory!

Solid State Tesla Coil

- Generate fiery electrical plasma discharge
- Powers light and objects without contact
- Experiment with electrical and mechanical fields. **TCL5 Plans $6.00**

TCL5K Kit/Plans 12VDC $59.50

Pioneer a Futuristic Weapon!

Electric Gun - prototype designed in our lab - Join the research!
- Ballistic Velocities
- Handheld • Battery Operated
- Labelled as DANGEROUS Product

Experiment now before it is classified as a firearm! **EGUN1 Plans $20.00**
(Must be 21 for purchase of hardware)

Ion Ray Gun
Project Energy! Star Wars technology demonstrates weapons potential. **IOG7K Kit/Plans $99.50**

4000 Volts **10ma High Voltage Module** - Ready to use - for many projects from hoverboards to pyrotechnics.
MINMAX4 *While they last!* **..... $19.50**

"Talking" Plasma Globe

Spectacular color. Pulsates to music, sounds!. 8-9", with intensity and sound controls. **PLASMA1 Ready to Use . $79.50**

Electronic Hypnotiser

Control their minds! Programmable audible and visual stimuli induces hypnotic trances. **HYP2K Kit/Plans $29.95**
EH2 Hypnosis Book $14.95

We can design and build high voltage systems- *to your spec's.*
Call or fax us with your requirements!

VISIT US ON THE WEB!
http://www.amazing1.com

INFORMATION UNLIMITED
Dept PEM-1, Box 716, Amherst, NH 03031
Phone: 603-673-4730 FAX: 603-672-5406
MC, VISA, COD, Checks accepted Please add $5.00 S & H

CATALOG!
FREE with Order or send $1 P&H

24 Hour Phone
800-221-1705
Orders Only Please!

Be a PC repair expert!

Approved home study. Learn to troubleshoot, repair, install, upgrade, and service computers.

Free literature: 800-223-4542

Name _____ Age _____

Address _____ Phone ( ) _____

City/State _____ Zip _____

School of PC Repair, DEPT JJK341, PCDI
6065 Roswell Road, Atlanta, Georgia 30328

Remote Automotive Engine Starters

Warm up your car in the winter. Cool it off in the summer.

SmartStart *MCS-100* ™ **Real Time clock based. Programs like a VCR. The engine starts at the times you set, up to 4 start times per day. Also set the run time, day and time.**

TouchStart *MCS-200* ™ **Start and stop the engine, and honk the horn with a 2 channel key chain transmitter up to 300 ft. away.**

Plans and parts list only.... $14.00 each + $3 S&H.
Send check or M.O. to: Modern Circuit Solutions Corporation
P.O. Box 212 Cedarburg, WI 53012-212

It could be a best seller. But it's free.

To get your free catalog, write:

Consumer Information Center
Dept. BEST, Pueblo, CO 81009

CABLE TV DESCRAMBLERS

To replace all TRI-MODE SYSTEMS (Stealth 1000, TNT, Appollo, TVT):

SYNTAX J Descrambler **$65.00** EA.
Box of 10 ..... **$42.00** EA.

PROTOCOL J Combo .....**$190.00** EA.
Box of 10 ...**$139.00** EA.

85 Channel Cable TV Converters (w/Remote, Parental Control, STD/HRC):

TPI 550-PC Converter ....**$75.00** EA.
Box of 10 .....**$60.00** EA.

SSA-TV86 Combo ..... ***Call***
To replace all SA8500-8580 and PIO 5xxx-61xx systems.

ORDERS CALL: **1-800-598-2364** (M-F 12-6 EST)

- All Orders Shipped COD
- UPS Ground
- Shipping & Handling add $10.00

IT IS NOT OUR INTENT TO DEFRAUD OR TO ASSIST ANY OTHER PERSON(s) AND/OR COMPANY(s) TO DEFRAUD ANY PAY TV OPERATOR(s). CUSTOMERS ARE OBLIGATED TO STRICTLY LIMIT USAGE OF PRODUCTS AND/OR INFORMATION OBTAINED FROM US TO WITHIN COMPLIANCE OF STATE AND FEDERAL LAWS.

If you are not getting this catalog you are missing out on some of the best deals in electronics today! We have thousands of items ranging from unique, hard-to-find parts to standard production components. Call, write, or fax today to start your free subscription to the most unique catalog in the industry, filled with super values on surplus electronic and hobbyist type items. If you have a friend who would like to receive our catalog, send us their name and address and we will gladly forward them a complementary 100 page catalog.

Why pay more? Call today.

MECI
340 East First Street
Dayton, Ohio 45402

Fax Order Line
1-800-344-6324

Order Toll-Free
1-800-344-4465

CIRCLE 48 ON FREE INFORMATION CARD

Pocket Cube™

Wireless cable box tester for authorized technicians. Surface Mount Technology. Works on J****** models D*5,D*V5,D*7,D*V7,D*BB, C*T,W*R.

Only $59.95 !

(plus $8 S&H)

30 Day Warranty

Pocket Cube with filter $69.95+S&H
Quantity discounts available.
Dealers Welcome!

NEW !

Pocket Cube Plus™
For testing of raw boxes.
CALL for current price !
Test chips available for J****** and SA8600.

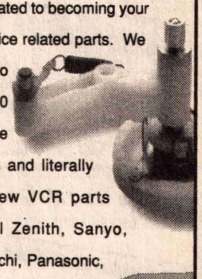
Order 1-800-417-6689

Mon-Fri, 9AM-5PM EST.
If busy please keep trying.

VISA, MC, MO or CASHIERS CHECK
IEC, P O Box 52347,Knoxville, TN 37950-2347
Pocket Cube is a test generator ONLY.
Do not use these devices without authorization from your local cable company and local officials.
Prices subject to change. No TN sales.
This ad quotes cash discount pricing.
Returns are subject to a restocking fee.

Parts Express™

Parts Express is dedicated to becoming your source for TV and VCR service related parts. We have taken this commitment to heart and added over 1,000 new original Japanese semiconductors and literally hundreds of new VCR parts including original Zenith, Sanyo, Fisher, Goldstar, Hitachi, Panasonic, JVC, RCA and much much more!



Call now for a **FREE** 228 page catalog packed with over 2,600 new items.

Source Code: POM

CALL TOLL FREE
1-800-338-0531

Parts Express 340 E. First St., Dayton Ohio 45402-1257
Phone: 513-222-0173 Fax: 513-222-4644

CIRCLE 150 ON FREE INFORMATION CARD

CABLE TV

Universal Descrambler
NEW PRODUCT

UNIVERSAL 5000 **$199.95**

Our fully assembled product is factory tested and *GUARANTEED* to work on your system.

MODEL 4000 KIT **$ 84.95**

The 4000 KIT comes with all the electronic parts and our Cad designed PC board. We provide parts list, full schmatic, wiring diagram and tutorial.

MODEL 4000A Enclosure **$ 44.95**

The 4000A Enc. Package will provide the hobbyist, who has our 4000 Kit, a custom enclosure, AC adaptor and finish accessories to enclose their kit.

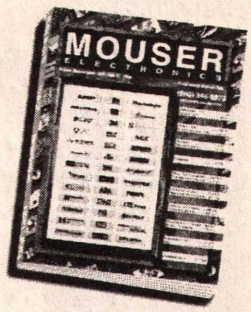
MODEL 4000 And 5000 Features

- **The latest in Video Amplification Technology.**
- **New clocking circuits to stabilize color and picture performance.**
- **The most advanced picture locking circuitry.**
- **Inverted Video Option is available.**
- **NO CONVERTER BOX is necessary.**

Call ***THG*** *Electronics* **1-800-664-6999**

IN STOCK

service \'sər - vəs\ *noun*
- The occupation of performing work or functions that benefit and contribute to the welfare of others.
syn. see **Mouser Electronics**



Call for your ***FREE*** *324 page catalog TODAY!*

65,280 Products
126 Manufacturers
All Orders Ship Same Day

- Passive Components
- Semiconductors
- Electromechanical
- Connectors/Cable
- Surface Mount and Through Hole

MOUSER® ELECTRONICS

800-992-9943
FAX: 817-483-0931
http://www.mouser.com
sales@mouser.com

958 North Main St., Mansfield, TX 76063

CIRCLE 138 ON FREE INFORMATION CARD

❖ ATTENTION CABLE VIEWERS ❖

CABLE VIEWERS. . .get back to your BASIC Cable Needs

Call 800-577-8775
For information regarding all of your BASIC cable needs.

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT
- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ **ANY SIZE** ORDER FILLED WITH SAME DAY SHIPPING

We handle NEW equipment ONLY - Don't trust last years OBSOLETE and UNSOLD stock!
COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator an we will not assist any company or individual in doing the same
*Refer to sales personnel for specifications

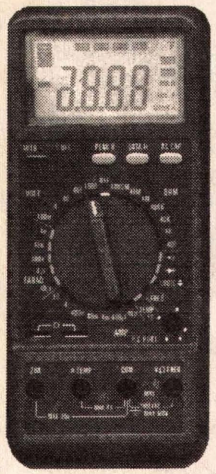
BASIC ELECTRICAL SUPPLY & WAREHOUSING CORPORATION

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

CALL TOLL FREE
(800) 292-7711
Se Habla Español

C&S SALES
EXCELLENCE IN SERVICE

WRITE FOR A FREE 60 PAGE CATALOG!



M-6100

Features:
- Computer Interface and Software with RS-232 Output
- Frequency to 4MHz
- Capacitance to 40nF
- Large 3 3/4 LCD display
- Temperature to 1999°F
- TTL logic
- Data/Peak hold
- Audible contiuity
- Auto power off
- Unit indicator
- Diode Test

NEW!

$125.00

TK-3000

$89.95

NEW!

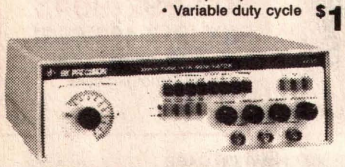
Tools Included:
- SR-2 - Deluxe Soldering Iron
- SH-1 - Soldering Iron Stand
- ST-1 - Diagonal Pliers
- ST-2 - Long Nose Pliers
- ST-30 - Deluxe Wire Stripper
- SE-1 - Solder Ease Kit
- ND-3 - 3 pc. Nut Driver Set
- TL-8 - Precision Screw Drivers
- ST-5 - Screw Driver Slotted 3/16"
- ST-6 - Screw Driver #1 Phillips
- ET-10 - IC Puller
- SP-2 - Solder Pump
- ST-20 - Safety Goggles
- ST-9 - Pocket Screw Driver
- ST-4 - Solder Tube
- SW-3 - Solder Wick

A professional technician service tool kit in a metal reinforced tool case with heavy-duty handle and locks. A removable pallet handles most of the tools listed with more room for tools and parts in the lower half.

2MHz Function Generator
Model 4010

- Sine, Square, Triangle, Pulse and Ramp output
- Variable duty cycle

$195.95

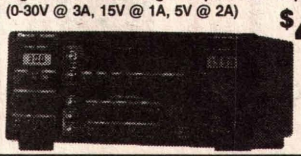


MX-9300 Four Functions in One

- One instrument with four test and measuring systems: 1.3GHz Frequency Counter • 2MHz Sweep Function Generator Digital Multimeter • Digital Triple Power Supply (0-30V @ 3A, 15V @ 1A, 5V @ 2A)

$479.95

NEW

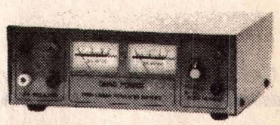


Model XP-581

4 Fully Regulated DC Power Supplies in One Unit

4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

$85



Digital Multimeter
Model EDM-83B

$169

18 Functions including freq to 20MHz, cap to 40µF, inductance to 40H, True RMS, Data Hold/min./max./avg., TTL logic.

Digital Multimeter
Model M-1700

$39.95

11 functions including freq to 20MHz, cap to 20µF. Meets UL-1244 safety specs.

Fluke Multimeters

70 Series
Model 70II . . . $69.95
Model 73II . . . $97.50
Model 75II . . . $135.00
Model 77II . . . $154.95
Model 79II . . . $175.00

80 Series
Model 83 . . . $235
Model 85 . . . $269
Model 87 . . . $289

B&K Precision Multimeters

Model 391 . . . $149
Model 390 . . . $139
Model 389 . . . $109
Model 388A . . . $99
Model 2707 . . . $79
Model 2860A . . $85

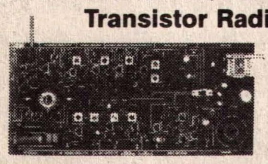
Kit Corner
over 100 kits available

PT-223K
$15.95

Phone kit with training course.

Fiber Optics Technology with training course
Model FO-30K
$19.95

Model AM/FM-108K
Transistor Radio Kit



$29.95

M-1005K
Compact Multimeter Kit

$19.95

6 Functions & Transistor Test

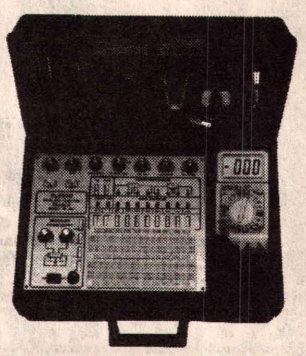
XK-550 Digital / Analog Trainer

Elenco's advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square wave forms.
1560 tie point breadboard area.

XK-550
Assembled and Tested
$169.95

XK-550K - Kit
$139.95

Tools and meter shown optional



WE WILL NOT BE UNDERSOLD

UPS SHIPPING: 48 STATES 5%
OTHERS CALL ($5 min. / $15 max.)
IL RES. 8% TAX

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

VISA MasterCard

15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 32 ON FREE INFORMATION CARD

FREE PROBES WITH ALL SCOPES

OSCILLOSCOPES

Lowest Prices of the Year!

WRITE FOR A FREE 60 PAGE CATALOG!

Japan Quality
But not Japan Prices!
Hitachi Laptop Color Digital Scopes

NEW! NEW!

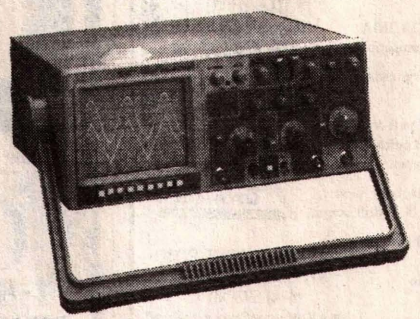
150MHz 60MS/s VC-5460 **$3695**
50MHz 30MS/s VC-5430 **$2695**
20MHz 15MS/s VC-5410 **$1795**

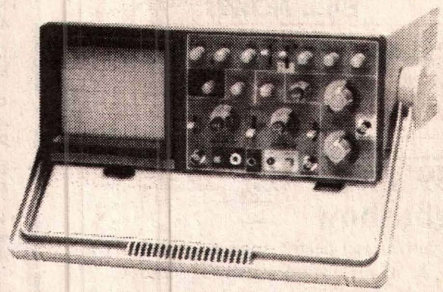
100MHz
VC-6145 - Storage 4 Channel 100MS/s . . . **$4795**
VC-6155 - Storage 100MS/s **$3995**
VC-6545 - Storage 40MS/s **$2995**
V-1585 - 4 Channel **$2095**
V-1565 w/ Cursors **$1795**
V-1560 . . . . . **$1595**

50/60MHz
VC-6525 - Storage 20MS/s **$2795**
VC-6524 - Storage 20MS/s **$2295**
V-695 - 60MHz w/ Cursors **$1549**
V-555 - w/ Cursors **$1095**
V-552 . . . . . **$949**
V-509 - Battery Operated . **$1795**

20MHz
VC-5025A - 20MS/s DSO w/ DMM **$1160**
VC-5025 - 20MS/s DSO w/ DMM **$935**
VC-6523 - Storage 20MS/s **$1995**
V-252 . . . . . **$449**
V-209 - Battery Operated . **$1425**

Quality Scopes by Elenco





60MHz

DS-603 $1350
- Analog / Digital Storage
- 20MS/s Sampling Rate

S-1365 $795
- Analog w/ Cursors

S-1360 $759
- Analog with Delayed Sweep

40MHz

S-1345 $569
- Analog with Delayed Sweep

S-1340 $489
- Analog

2 Year Warranty

25/30MHz

DS-303 $1095
- Analog / Digital Storage

S-1330 $439
- 25MHz Analog
- Delayed Sweep

S-1325 $335
- 25MHz Analog

OSCILLOSCOPE SELECTION CHART

ANALOG

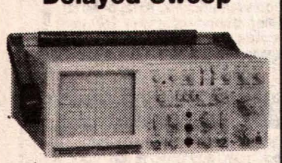
Model	Bandwidth MHz	Sensitivity (max)	No. of Channels	Sweep Rate Max ns/div	Delayed Sweep	Video Sync	Component Tester	Beam Find	Time Base
S-1365	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1360	60	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1345	40	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1340	40	1mV/div	2	10ns/div	No	Yes	No	No	1
S-1330	25	1mV/div	2	10ns/div	Yes	Yes	Yes	Yes	2
S-1325	25	1mV/div	2	10ns/div	No	Yes	No	No	1

DIGITAL STORAGE

Model	Bandwidth MHz	Analog Sen (max)	No. of Channels	Sampling Rate	Memory Channel	Internally Backed Up	Pretrigger %	Output
DS-303	30	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232
DS-603	60	1mV/div	2	20MS/S	2K	Yes	0, 25, 50, 75	RS232

B&K Precision at Discount Prices

20MHz Analog
2120 - $389.95
2125 - $539.95
Delayed Sweep



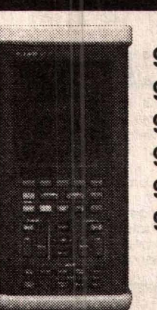
Model 1541C
40MHz
$695
Dual Trace

Model 2160
60MHz Dual Trace
$949
Dual Time Base • Delayed Sweep

60MHz with Cursors readouts and Dual Time Base
Model 2260
$1225

Model 2190A
100MHz 3 Channel
$1379
Dual Time Base • Delayed Sweep

Fluke Scopemeters



91 . . . . . **$1225**
92 . . . . . **$1525**
96 . . . . . **$1795**
97 . . . . . **$1795**
97A **$2945**
99 . . . . . **$2095**
Call or write for complete specs.

WE WILL NOT BE UNDERSOLD

UPS SHIPPING: 48 STATES 5%
OTHERS CALL ($5 min. / $15 max.)
IL RES. 8% TAX

C&S SALES, INC.
150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

VISA MasterCard

15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 32 ON FREE INFORMATION CARD

"FULL VIEWING" CABLE BOXES

FREE

Converter Box Catalog
Open Every Day!

LOWER YOUR CABLE BILL *NOW!*

CHANNEL SURFERS

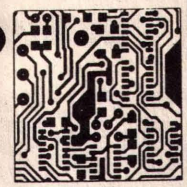
1-800-447-7634

NEW EASY PC

BRITISH DESIGN AWARD

SCHEMATIC and PCB C.A.D

ONLY $145



Includes

- MGA, CGA, EGA & VGA compatible.
- Design large multi layer boards.
- One level pull down menu and quick keys for fast layout.
- Dot matrix, laser, plotter, Gerber & N.C. drill output.
- 6 Month Free update Free Demo

OHIO AUTOMATION Inc.

7840 ANGEL RIDGE ROAD
ATHENS, OHIO 45701
(614) 592-1810
Visa & MasterCard Accepted

WHOLESALE PRICES
STARTING AS LOW AS $99.00

CABLE TV DESCRAMBLERS

CONVERTERS
FILTERS · VIDEO STABILIZERS

1 Year Warranty on All Products.
Affordable Extended Warranty.
FREE CATALOG!

30 Day FREE TRIAL

Call the Cable Professionals 24 Hours A Day!

C.O.D.

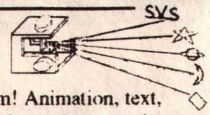
Orion Electronics

1-800-379-3976

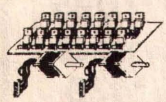
HTTP://WWW.ORION-ELECTRONICS.COM

$139* Laser LightShow

SVS



Draw with a laser beam! Animation, text, music & more! Includes galvos, mirrors, servo amp, demo software disk, analog and digital computer interface. Use an inexpensive pen pointer or high power gas laser.



Computerized Motors $39*

Includes: 2 Stepper motors, 2 DC motors, computer interface, training manual, & demo software disk. Expandable! Up to 12 motors, up to 3 amps per phase.

Now with 4 Axis Linear Interpolation

* Add $6 for shipping. Computer with parallel printer port & cable, assembly, power supply, & laser are required

FREE FLYER

Voice 510-582-6602 Fax 510-582-6603

SVS 1273 Industrial Pky. West Bldg. 460 PO Box 55125 Hayward CA 94545-0125

CABLE T.V.
DESCRAMBLERS
Lowest prices, guaranteed!
CFS Electronics
(formerly C & C Electronics)
(800) 995-1749
VISA, MC, AMEX, C.O.D.

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK

PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SIP TESTER EMUPA

CALL ADVANTECH LABTOOL	629 EETOOLS SIMMAX
689 ICE TECH MICROLV	795 CHROMA SIMM/SIP
669 EETOOLS ALLMAX +	350 MOD-MCT-EMUPA/R
429 EETOOLS PROMAX	279 MOD-MCT-EMUP/R
439 EETOOLS MEGAMAX	49 EPROM 1G TO 512K
539 EETOOLS MEGAMAX4	79 EPROM 1G TO 1MEG
429 XELTEK SUPERPRO II	99 EPROM 4G TO 1MEG
529 XELTEK SUPERPRO II P	199 EPROM 16G TO 1 MEG
269 XELTEX SUPERPRO L	99 EPROM 1G TO 8MEG
179 XELTEK ROMMASTER II	129 EPROM 4G TO 8MEG
479 MOD-MCT-EMUPA	250 EPROM 8G TO 8MEG

LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments

Sales 408-241-7376 Fax 241-6375 BBS 983-1234

Web www.generaldevice.com E-Mail icdevice@best.com

BE A LOCKSMITH!

Home study. Learn locksmithing for a great career, or to start your own at-home business.

FREE LITERATURE: 800-223-4542

Name _____ Age ____

Address _____ Phone _____

City _____ State ____ Zip _____

The School of Locksmithing, Dept. LKK341
PCDI, 6065 Roswell Rd., Atlanta, GA 30328

WORK AT HOME!

Only You Can Prevent Forest Fires.

Ad Council

Weeder Technologies

Electronic KITS!

Call for FREE CATALOG!

From $29 to $55

Pro-Kit™

PO Box 421, Batavia, OH 45103

513-752-0279

Home Automation

Connects between a TW523 and an RS-232 serial port. Use your PC or Mac to receive and transmit all X-10 commands. Create your own program to control your home automation system, turning on/off any device plugged into an electrical outlet with responce to time/date, other X-10 transmissions or any other computer input stimuli.

Caller ID / RS-232

Connects between a telephone wall jack and an RS-232 serial port. Decodes the caller ID data sent over the phone line and sends it to your PC or Mac, in a pre-formatted ASCII character string. Create your own program to log the name, number, date, and time of all incoming calls.

Telephone Call Restrictor

Connects to telephone wall jack. Disables all phones on the line if attempting to either: dial a number that has been stored in memory "Block" mode or, dial a number that has not been stored in memory "Allow" mode. Use touch-tone phone to enter telephone numbers into memory, and choose mode. Program from any phone on the line using your password.

50 MHz Frequency Counter

Reads frequency from 1Hz to 50MHz and displays up to 7 digits on a 16x1 character LCD display. Auto-range feature provides floating decimal point and automatically affixes the correct suffix (Hz, KHz, or MHz). Microcontroller based provides for very small parts count, only 2" x 3" big.

Telephone Scrambler

Scrambles your voice before sending it over the telephone line. Prevent eavesdropping from an extension or tap. Connects between your telephone and wall jack. No modifications are required to your telephone. Full duplex operation.

IR Remote Control Receiver

Learns and records the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. Seven individual I/O pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action.

Vocal Filter

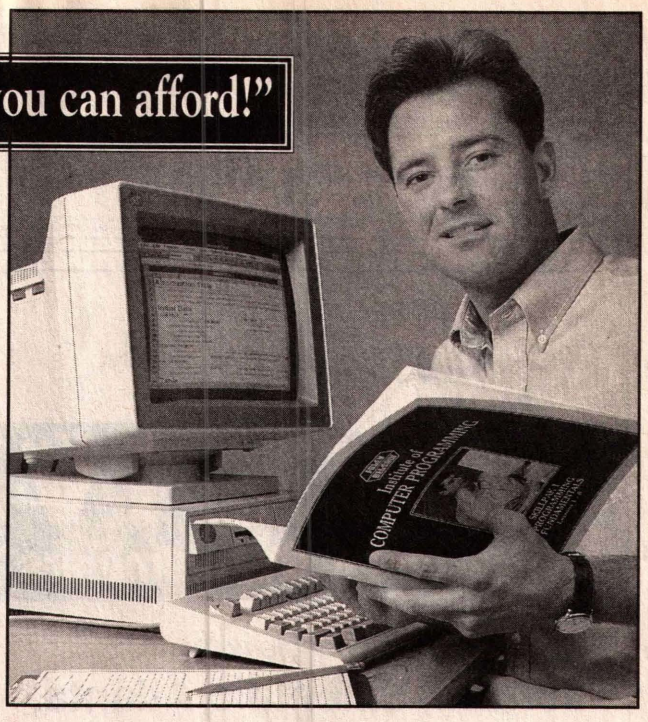
An audio device which can be used with a home component stereo system to filter out the main vocal sound track from standard stereo recordings (CD, tape, record or FM), leaving the background music to sing along with. Produce your own karaoke tapes from your personal library.

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Connects to your telephone wall jack. Decodes all 16 touch-tones and displays them on an LCD display. Holds the last 240 digits in a nonvolitile memory. Scroll through and view all telephone numbers dialed, credit card numbers entered, etc.

"Get the skills you need at a price you can afford!"

Earn up to $45 an hour or more as a skilled Computer Programmer.



Cash in on the explosion of opportunities. Start your new career or even open a business of your own as a highly-paid computer programmer.

Computer programmers today can almost write their own ticket to financial well–being and job satisfaction. Only Foley–Belsaw's unique in–home training programs can give you the skills you need at a price you can afford.

You'll learn the three hot computer languages — QBasic, C and Visual Basic. You'll even work with the hot new C++. With this easy–to–learn knowledge, you'll write your first QBasic program by the end of the first SkillPak of lessons. Soon you'll be programming sound and graphics, and even learning how to program for the Windows environment — the most popular application program today.

It's easy to cash in!

Look at some of the things professional computer programmers do. "Wrote a C program to clean up a WordPerfect file; edited the resulting file as data errors were found." This work would take a trained programmer less than five hours to complete, and they could make over $200 for the work. That's money you could be making — and soon — with training from the Foley–Belsaw Institute of Computer Programming.

Everything is included!

We provide you with all the materials you'll need to become a professional computer programmer. You'll receive 37 lessons, designed for you by the Foley–Belsaw Professional Programmer Staff. Other valuable materials include a *Programmer's Handbook*, Programmer's Examples on two 3.5 inch disks, Programmer's Flowchart Template, and a booklet, *Selecting the Right Computer*.

Other schools force you to buy a complete computer package as part of their training program. At Foley–Belsaw we understand that your needs as a programmer may not fit into a "one size fits all" approach. Why should you pay hundreds of dollars for a computer system that you may not need?

We'll tell you what you need to know so that when you're ready to buy your own computer, you can get the machine that fits your needs at the lowest possible price. That's the Foley–Belsaw way.

Get the free facts today.

Whether you want to change careers, have a profitable part-time job or start your own business, Foley-Belsaw Institute's new computer programming course is the first step. A profitable future in computer programming can be yours. Call or write today for a fact-filled information kit including a free copy of *Computer Programming — A Profitable Career In Your Spare Time*. See how easy it is to begin a money-making career as a sought-after computer programmer. Our free full-color information kit outlines the steps of the computer programming course and shows you everything you will receive as part of your training.

Mail this coupon or call today
Toll Free 1-800-487-2100!
Your free opportunity kit will be rushed to you!

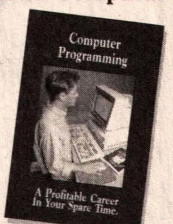
If coupon is missing, write to: Foley-Belsaw Company, 6301 Equitable Road, Kansas City, MO 64120

Call or complete & return this coupon to: Foley-Belsaw Institute,6301 Equitable Road, Kansas City, MO 64120

❑ **YES! Rush me a free information kit on Computer Programming right away**. Dept. 35251

Other career courses:

- ❑ Locksmithing, Dept. 12840
- ❑ Small Engine Repair, Dept. 52718
- ❑ Saw & Tool Sharpening, Dept. 21659
- ❑ VCR Repair, Dept. 62531
- ❑ Computer Repair, Dept. 64428
- ❑ TV/Satellite Dish Repair, Dept. 31303
- ❑ Gunsmithing, Dept. 92328
- ❑ Woodworking, Dept. 43592
- ❑ Upholstery, Dept. 81261
- ❑ Vinyl Repair, Dept. 71194
- ❑ Electrician, 95109
- ❑ Computer Specialist, 38102
- ❑ Networking Specialist, 39089



FOLEY BELSAW
Since 1926

I understand that there is ABSOLUTELY NO OBLIGATION and NO SALESMAN WILL CALL.

Name _____

Address _____

City _____ State _____ Zip _____

M.E.T.

TRANSISTORS CD - BOOK + Free A Multimedia Guide: Theory of Transistor

E-MAIL: METZA@INFOBOARD.COM

CD-Rom

MORE THAN 27,000 TRANSISTORS Only $33

Reference Table - Comparison Table
20 Technical data and drawings for each transistor.

Prototype it..... FAST!

with ProtoQuick 8051 or Z8

- Complete single board computers
- Up to 32K EPROM and 8K RAM
- 12 sq. in. plated-through proto area
- RS232 C serial port w/ DB25 conn.
- Op. sys. in EPROM w/ source code
- Assembled, ready to run - 5v only
- MS-DOS cross-assembler included

ProtoQuick Z8 and 8051

$99.00 each

Run prototype applications or experimental hardware from the serial port - WITHOUT PROGRAMMING!

Software Science
Software Science
3750 Roundbottom Road
Cincinnati, OH 45244 USA
(513) 561-2060

NEW 18" Dish System

Featuring the DISH NETWORK

- MORE Programming Choices!
- Save 30-60% on Programming. Compare to Cable and other 18" Dishes!

800-500-9264

YOU CAN

Skyvision, Inc. 1038 Frontier Dr. Fergus Falls, MN 56537

See full page ad in The Market Center

Greenleaf ELECTRONICS

CABLE TV
Converters & Descramblers

Compatible with

Jerrold, Scientific Atlanta, Pioneer, Oak, & Hamlin

Equipment

BRAND NEW!

6–MONTH GUARANTEE

LOWEST PRICES

Volume Control & Parental Lockout Available

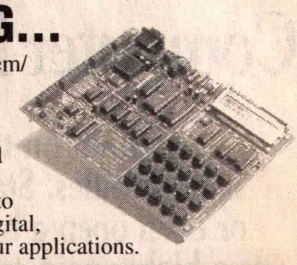
Greenleaf Electronics

1-800-742-2567

NO ILLINOIS SALES

It is not the intent of Greenleaf Electronics to defraud any pay television operator and we will not assist any company or individual in doing the same.

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...



...with the AES learning system/ embedded control system. Extensive manuals guide you through your development project. All programming and hardware details explained. Complete schematics. Learn to program the LCD, keypad digital, analog, and serial I/O. for your applications.

THREE MODELS AVAILABLE. Choose from an Intel 8051, Intel 8088, or Motorola 68HC11 based system. All models come with:

•32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts,timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly,BASIC, and C programming(varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details(over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From $279.
Money Back Guarantee

Call for Free Info Pack, or see WEB at http://www.aesmicro.com
714-550-8094,FAX 714-550-9941

AES Advanced Educational Systems

Call 1-800 -730-3232

AES 970 W. 17TH STREET, SANTA ANA, CA 92706, USA

CABLE TV DESCRAMBLER KITS

Universal-New Product

This Product includes all the Parts, PC Board, Complete Schematic with Functional Guide. Generates Sync for most Video Applications.

$84.95

Tri-Mode Descrambler

This product includes all the parts PC Board and AC Adaptor. NO Enclosure included.

$59.95

Universal 5000

Our fully assembled product is factory tested and GUARANTEED to work on your system.

$199.95

MasterCard

Call Toll Free 1-800-886-8699

M & G Electronics, P.O. Box 3310. No. Attleboro Mass. 02761

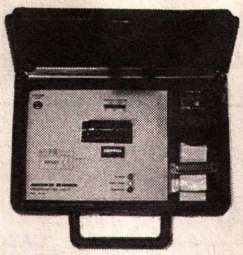
VISA

Anyone implying theft of Cable service will be denied assistance.

NO MASSACHUSETTS SALES!

EPROM+

PROGRAMMING SYSTEM USES PARALLEL PORT



EPROMS (24,28,32 & 40 PIN*)+27C AND 25XX
1702*,2708,**TMS2716***,32,32A,64,64A,128,128A
256,512,513,011,010,101,1001,1000,1024,210,020
2001,220,2048,4001/2,040,080,240,4096,68764/66
FLASH EPROMS 28F256, 28F512, 28F010
28F020,29C257,29C010,29C040,29F010,29F040
EEPROMS & NVRAMS (18,24 & 28 PIN+CXX)
2210, 2212, 2804, 2816, 2816A, 2817, 2864, 2865
28256, 28C010, DS1220, DS1225, DS1230
SERIAL EEPROMS* (8 & 14 PIN PLUS CXX)
ER1400,M58657, 2401,02,04,08,16,32,65, 2444
59C11,80011A,9306,46,56,66,8572,82,92,168/9XX
BIPOLAR PROMS* (16 THROUGH 24 PINS)
74SXXX AND 82SXXX FAMILY
MICROCONTROLLERS* 8741, 42, 48, 49, 8751
C51, 52, C52, 87C5XXX, 87C75X, 89C5X, 68705
68HC705, 68HC711E9, PIC16CXX, TMS7742
*ADAPTER REQUIRED - DIAGRAMS INCLUDED

SOFTWARE - READ,VERIFY,PROGRAM,COPY DISK FILE LOAD/SAVE, CHECKSUM, FULL SCREEN BUFFER EDITOR W/20 COMMANDS
READS HEX, S-RECORD AND BINARY FILES
FAST-DEVICES PROGRAM IN UNDER 20 SEC
RUGGED (9"X6"X3")ENCLOSURE W/HANDLE
MADE IN USA - 1 YEAR WARRANTY

SYSTEM INCLUDES:
PROGRAMMING UNIT
PRINTER PORT CABLE
POWER PACK, MANUAL
AND SOFTWARE.

$289

ADD $5.00 SHIPPING
$5.00 C.O.D.
VISA/MASTERCARD

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
(513) 831-9708 FAX (513) 831-7562

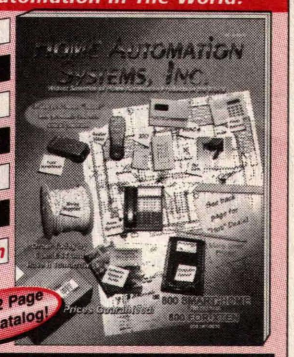
HOME AUTOMATION

Largest Selection of Home Automation in The World!

Computer Control of Your Home!

- *Lighting*
- *Audio/Video*
- *Security Systems*
- *Video Surveillance*
- *Phone Systems*
- *Heating/Cooling*
- *Pet Care Automation*

Widest Range of X-10 Devices



HOME AUTOMATION SYSTEMS, INC.
151 Kalmus Dr., Ste. L4
Costa Mesa, CA 92626
Questions: 714-708-0610
FAX: 714-708-0614

Call **800-SMART-HOME**
24 Hours 800-762-7846
E-mail: catalog@smarthome.com
http://www.smarthome.com/smarthome

CABLE TV DESCRAMBLERS

Never rent again! Save $100's on premium Cable TV Descramblers & Converters compatible with Jerrold, Scientific Atlanta, Zenith, Pioneer, Tocom and More! Get your best prices and call us last! Please have the MAKE & MODEL # of your area's cable box ready.
GUARANTEED TO WORK IN YOUR AREA!
1 year warranty and 30 day money back guarantee!
Allstar Electronics 1-800-782-7214

Debco is a Kit Builders Paradise

Electronic Kits - Plans - Parts - Computers - Amateur Radio

Call Debco today for your **FREE** copy of The Electronic Experimenter's Journal

1 800 423 - 4499

Debco Electronics 4025 Edwards Rd. Cincinnati, OH 45209

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome
Call VISION TIME PRODUCTS
1-800-310-1153 M-F 8a-8p
NO TENN SALES

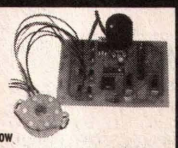
SOLAR POWERED HAT FAN

- **Solar Powered**
- **Durable Fan in bill**
- **Keeps you Cool!**
- **Adjustable Fit**

Keeps you cool on hot days, while working or playing. Makes a great gift.! Specify color: red, light blue, navy blue, white, and yellow.
SPHF-1 ..... $15.00ea.

STEPPER MOTOR CONTROLLER KIT

- **Adjust speed**
- **Change direction of rotation.**
- **Single step or Continuous stepping**



Easy to assemble! LED's show sequence of motor steps. Runs on 12VDC. Includes Stepper Motor, PC Board, Parts, and Instructions.
SMK-1 ..... $25.00

CAMCORDER VIDEO TAPE

- **HI-8**
- **P6-120 HMPX**
- **Major Brand Name**
- **Excellent Condition**
- **Jewel Box Included**

HI-8 120 minute video cassette tape (used). They were recorded on once and played a few times. Then bulk erased. Ready to record on again.
CCT-1 . .$3.00ea/10+ 2.80ea/50+ 2.65ea/100+ 2.50ea

SUPER VHS VIDEO TAPES (USED)

- **Super VHS Tapes**
- **T-120Minute**
- **Major Brand Names**
- **Excellent Condition**
- **Great Price!**

These tapes were used for a brief period, then bulk erased. The record tabs have broken out, so you will need to cover the notch with a piece of tape.
S-VHS . .$3.00ea/10+ 2.80ea/50+ 2.65ea/100+ 2.50ea

MINIATURE FM TRANSMITTER KIT

- **Powerful 2 stage Audio Amplifier**
- **Tunes 100-108Mhz**
- **Requires 9V Battery (Not Included)**
- **Sensitive mike picks up Whispers**

Works with any FM radio or broadcast receiver. Easy to assemble.
FM-32 ..... $10.95

MINI PHONE TRANSMITTER KIT

- **Small Phone Transmitter**
- **Tunes 90-95Mhz**
- **Attaches to phone line any where in home.**
- **Powered by phone line.**

Use with any FM radio or broadcast receiver. Easy to assemble. Just lift the handset to activate.
FM-16 ..... $9.95

AMAZING EMERGENCY FLASHLIGHT

- **Hand Powered!**
- **Never needs batteries**
- **Operates even underwater!**

Never be caught without a flashlight again due to dead batteries. Dynamo produces power to provide light. Great for the car, boat, and house.
EL-1 ..... $9.95

DC MOTOR SPEED CONTROLLER KIT

- **Control speed**
- **Clockwise or Counter Clockwise Rotation**
- **Runs on 6 to 12VDC**

Easy to build. Control speed and direction of small DC motors. Includes PC Board, Motor, Parts, and Instructions.
MSC-1 ..... $15.00

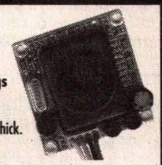
VIDEO CLARIFIER

- **Eliminate Copyguards!**
- **Auto Sync Boost**
- **Fully Automatic**
- **State-of-the Art Circuitry**

Allows for flawless viewing of all pr orded tapes. Restores tapes to broadcast quality. Eliminates annoying interference. Compatible with all VCR's and T.V.'s. Operates on 4 AA batteries. (Not Included)
VC-3 ..... $49.95

B/W PINHOLE CAMERA WITH AUDIO

- **Pinhole with Audio**
- **Ultra Miniature!**
- **3.7mm lens**
- **Prewired with RCA plugs**



Ultra mini camera measures 1 3/16" x 1 3/16" x 9/16" thick. 420 Horizontal lines. .1 Lux Runs on 9-12VDC@100ma
PHC-1 ..... $159.95

MINI B/W CAMERA W/STAND

- **B/W CCD CAMERA**
- **Prewired with RCA Plugs**
- **Metal Housing • Stand w/Hardware**
- **Adapter Included**

Measures 3 7/8" Long (Including Lens) x 1 1/4"W x 1"H Small enough to fit in your hand! Has 0.2 Lux, 400 TV lines, operates on 12VDC@1.5W. Includes stand & power adapter, & prewired with RCA plugs.
CCD-2 ..... $159.95

ULTRA PLIER 14 FUNCTION TOOL

- **Ultra Plier**
- **14 Functions**
- **Ultimate Handy Tool!**
- **Fits in the Palm of your Hand!**

You have every type tool in one implement. Includes Pry Bar, Wire Cutter, 2 Wire Strippers, Phillips Screwdriver, 2 Flathead Screwdriver, File, Small Blade and Bottle Opener. Comes with Nylon Pouch.
Plier $12.95

CALL TOLL FREE
1-800-526-3717

SATISFACTION GUARANTEED

645 Temple 7E ▲ Long Beach ▲ California 90814
▲ (310) 434-5641 ▲ FAX (310) 434-9142 ▲

1. California residents must include sales tax.
2. Visa, MC, & money orders accepted
3. Quanties limited – prices subject to change.
4. Shipping $5.^{00}$ & up.

Black Feather ELECTRONICS

Converters & Descramblers
Call 1-800-715-6789

30 Day Money Back Guarantee

FREE Catalog

illennium ENTERPRISES

...It's Full of Stars

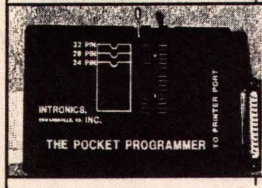
- Panasonic®
- Jerrold®
- Pioneer®
- Zenith®
- Scientific Atlanta®

ALL MAJOR CREDIT CARDS ACCEPTED

13492 Research Blvd • Suite 120-113 • Austin, TX 78750

The Pocket Programmer

$129.95



The portable programmer that uses the printer port of your PC instead of a internal card.

Easy to use software that programs E(E)prom, Flash & Dallas Ram. 27(C)/28(C)(F)/29(C)(F)/25 series from 16K to 8 Megabit with a 32 pin socket. Adapters available for MCU's 874X, 875X, Pic, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang and Eprom Emulator to 32K X 8.

Same Name, Address & Phone # for 13 Years.... Isn't it Amazing ?

Intronics, Inc.
Box 13723 / 612 Newton St.
Edwardsville, KS 66113 Add $4.75 COD
Tel. (913) 422-2094 Add $4.00 Shipping
Fax (913) 441-1623 Visa / Master Charge

There's a life
to be saved right now.

Please give blood.

Call 1-800 GIVE LIFE

Ad Council

American Red Cross

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome
Call VISION TIME PRODUCTS
1-800-310-1153 M-F 8a-8p
NO TENN SALES

CLASSIFIED

CABLE TV

"BULLET Buster." Protect your cable box against the infamous cable "bullet." The "Bullet" Buster acts as an electronic shield. Installs in-line in seconds. Don't wait until it's too late! $19.95 +$3.00 S&H. Visa/MC/Amex. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

CABLE —safe. Guarantee cable privacy. The one way valve for your cable TV signal. Cable signals come in, but they don't go out! $29.95, + $3.00 S&H. Visa/MC/Amex. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

CABLE unscrambled. Everything you want to know about cable, but are afraid to ask. $10.00. Visa/MC/Amex. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

"DESCRAMBLER Schematics Revealed." A powerful guide to descrambling schemes. $10.00. Visa/MC/Amex. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

UNIVERSAL descrambler. Unscramble signals using your VCR as the tuner. Works with virtually any system, this is the only one you need. Declare cable box independence! $129.95 + $5.00 S&H. Visa/MC/Amex. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

"BASEBAND Video Explained". Discover what a Baseband Signal is and how it's constructed. Learn the advantages of doing things the "Baseband" Way. $10.00. Visa/MC/Amex. **ELECTROMAN,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

ATTN. CABLE box owners! Order your ID signal stopper now. Send $23.00 to **R.R. ENTERPRISE,** Box 3532, Easton, PA 18043.

CABLE descrambling, new secret manual. Build your own **descramblers** for cable and subscription TV. Instructions, schematics for **SSAVI,** gated sync, sinewave, some free methods (HBO, Cinemax, Showtime, UHF, Adult) $12.95, $2.00 postage. **CABLETRONICS,** Box 30502PE, Bethesda, MD 20824.

SECRET cable descramblers! Build your own descrambler for **less** than $12.00 in **seven easy steps! Radio Shack** parts list and **free** descrambling methods that **cost nothing** to try, included. Send $10.00 to: **INFORMATION FACTORY,** PO Box 669, Seabrook, Texas 77586. For Visa/MC, COD's, (713) 922-3512 Anytime!

CABLE TV equipment & accessories. Wholesalers welcome! 30 day moneyback guarantee! Free catalog! **PERFORMANCE ELECTRONICS, INC., 1 (800) 815-1512.**

CABLE descrambler! Anyone can build in seven steps with Radio Shack parts. Plans $5.00. 1 (800) 818-9103.

DESCRAMBLE cable using simple circuit. E-Z to follow instructions $10.00. Complete universal kit with free Bullet "Terminator". $20.00. 1 (800) 522-8053.

CABLE TV Test Chips for Jerrold, Tocom, Pioneer, Scientific Atlanta, etc... **Quick installation!** New Multi-Mode modules available. Prices from $5.00 each. **1 (800) 786-9025.**

CABLE bullet "Terminator/I.D. Blocker". Electronically shields yourself and your box. Factory direct. Lifetime guarantee. $14.95. 1 (800) 820-9024.

CABLE TV notch filters. Tunable from 50 to 300 Mhz (channels 0 thru 36). Eight different models available so specify frequency or channel number needed when ordering. $30.00 each plus $3.50 S/H per order. Huge quantity discounts. **STAR CIRCUITS,** PO Box 94917, Las Vegas, NV 89193, 1 (800) 433-6319.

CABLE Filter, build your own — Plans, parts, PC Board, case, $11.00. **VIDEO MEDIA,** Box 97-0408, Coconut Creek, FL 33097. 1 (954) 752-9202.

DESCRAMBLE Cable with simple circuit added to Radio Shack RF modulator and using VCR as tuner, instructions $10.00. **TELCOM,** PO Box 832 P9, Brusly, LA 70719.

WHOLESALE cable descramblers and converters. Zenith ST1600 special. 10 lot price $175.00 each with remote. D&M, **1 (800) 550-8815.**

CABLE TV descramblers. One piece units. Pioneer 6310's, Scientific Atlanta 8580's, DPV7's and others. Lowest prices. Money back guarantee. Houston, TX (713) 691-4610.

HAVE a beeping or chirping sound with scrambled video on channels. We can help. Professional quality positive notch filters. Discounts on 5 or more. Fast courteous service. All credit cards. New universal type 1-piece cable units w/ volume control and parental lockout for all systems. Call 1 (800) 684-0539.

CABLE descramblers. Bargain headquarters, below wholesale prices. Absolutely the lowest prices! Money-Back guarantee. Nobody beats us! RP ELECTRONICS, 1 (800) 304-3604.

CABLE descramblers. Buy direct. Rock bottom prices. #1 in customer service and low prices. All brands...**THE CABLE CONNECTION** 1 (800) 411-2662.

CABLE descrambler kit. Only $12.95 if you mention this magazine with your order. (Regularly $15.00.) 1 (800) 484-8098. Ext. 7247.

CABLE converters and **test modules.** Money back guarantee. Extremely competitive. Wholesale pricing. Catalog. Credit cards. 1 (888) 443-9185.

MISCELLANEOUS ELECTRONICS FOR SALE

THE Case Against Patents. Thoroughly tested and proven alternatives that work in the real world. $28.50. **SYNERGETICS PRESS,** Box 809-C, Thatcher, AZ 85552. (520) 428-4073. Visa/MC.

57 Electronic Journals. How to get free subscriptions. $5.00. **CABLETRONICS,** Box 30502PE, Bethesda, MD 20824.

POOR reception on your A.M. radio? Our signal booster will help. Guaranteed! Send $2.00 for details (refundable with order). **FALA ELECTRONICS,** PO Box 1376, Dept. 4, Milwaukee, WI 53201.

NEW personal computer **measurement, monitoring, control, data transmission** peripheral. Connects serial port. Complete; simple. Includes software. Affordable! Information: **TESCO,** Box 53743, Lubbock, TX 79453.

PLANS-KITS-SCHEMATICS

TRANSISTOR Data Tables — Given are the basic electronic parameters for the worlds popular transistors in one volume. A must for servicemen, hobbyists and engineers. Order "Transistor Data Tables" (BP401) for only $9.95 (price includes shipping) from **ELECTRONIC TECHNOLOGY TODAY, Inc.,** PO Box 240, Massapequa Park, NY 11762-0240. USA and Canada only. US funds.

FIBER optic educational experiments kit. Includes: Tutorial, w/experiments, 40ft fiber assortment, + cutting tool. $19.95 + S/H **1 (800) 373-7078.**

CRYSTAL Set Handbook — Visit antiquity by building the radios your grandfather built. Assemble a "Quaker Oats" rig, wind coils that work and make it look like the 1920's! Only $10.95 plus $4.00 for shipping and handling. **CLAGGK INC.,** PO Box 4099, Farmingdale, NY 11735. US funds only! USA and Canada — no foreign orders.

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. Phone: (616) 925-5899, 8-4 ET.

NEURAL Network. Study and build this fascinating learning synthetic brain. Details: **THINK-2,** 2-89 Emma, Guelph, ON, N1E-1V1.

MINIATURE FM transmitters. Sensitive! Powerful! SASE for catalog. 1764 N. Sycamore #215, Dept. PE, LA, CA 90028.

SILENT Sam turn signal reminder. (Patented). Keeps you from going down the road flashing, inadvertently. $30.00 postpaid, Visa/MC 30 day money back guar. Literature available. Toll free 1 (800) 398-5605.

SAVE money! Build your own test equipment from kits. Free information: **MIKE PEASGOOD,** 504-611 Heritage Drive, Kitchener, Ontario, Canada N2B 3J3.

AWESOME Kits: Voice changer, levitator, laser, gas sensor and more! Catalog $1.00. **LNS TECHNOLOGIES,** 20993 Foothill Blvd., Suite 307R, Hayward, CA 94541.

TEST EQUIPMENT

WAVEFORM Generator, 1Hz to 20MHz installs in PC ISA slot, DOS and Windows Control Software. Free information. **ASTROSOFT,** 15006 La Mesa, St. Sylmar, CA 91342.

TECHNICAL manuals: Tektronix scopes T932/T935, T932A/T935A, Type 453, Spectrum Analyzer 492/492P; HP Logic Analyzer 1607A; Sencore LC53 "Z Meter". (912) 922-3821.

BUSINESS OPPORTUNITIES

START your own technical venture! Don Lancaster's newly updated **Incredible Secret Money Machine II** tells how. We now have autographed copies of the Guru's underground classic for $18.50. **SYNERGETICS PRESS,** Box 809-C, Thatcher, AZ 85552. (520) 428-4073. Visa/MC.

FREE invention package: DAVISON & ASSOCIATES offers customized development, patenting, and licensing of new product and ideas. Proven results: 1 (800) 677-6382.

GET paid $268.20/ roll taking easy snapshots! No experience. Film supplied. **PHOTOTEK,** Box 3706-PE, Idyllwild, CA 92549. (909) 659-9757 Ext. 122.

OFFSHORE banking. A complete guide to services offered in the Cayman Islands. One of the worlds leading offshore centers. Includes: How to protect your assets from taxes, electronic banking, sample account forms and a directory of banking institutions. $15.00. **TRI INVESTMENTS, LTD.,** PO Box 35H, Cayman Islands, BWI.

REPAIR training video for Super Nintendo. Pays for itself in two repairs. Free parts flyer with order. $39.95 + $4.00 S&H. **WITT ELECTRONICS,** Box 1621, Southampton, PA 18966.

COMPUTER EQUIPMENT WANTED

FLOPPY disc and instruction manual for Zenith computer model E1H/2FG-121-32. Serial no. 301 EH 0044. **THOMSON,** (409) 986-5275.

CB-SCANNERS

SCANNER owners send $8.00 and SASE for 308 California police codes and definitions. **SANDRA RODRIQUEZ,** information address: PO Box 212A, Morgan Hill, CA 95038.

EDUCATION

LEARN IBM PC Assembly Language. Disk $5.00, Book $18.00. **ZIPFAST,** Box 12238, Lexington, KY 40581-2238.

WINDOWS 95 Kickoff — Staring at Windows 95 and not knowing what to do? Then get your personal copy of "Windows 95-One Step at a Time" (BP399). Only $9.95 (price includes shipping) from **ELECTRONIC TECHNOLOGY TODAY, INC.,** PO Box 240, Massapequa Park, NY 11762-0240. USA and Canada only. US funds.

FCC/CET software. General Radiotelephone, CET preparation. Five 3.5 inch diskettes. Q/A format: interactive, comprehensive. EGA/VGA. Complete program, $35.00. **TUTOR-TECH,** 170 Locksunart Way, #2, Sunnyvale, CA 94087. (408) 481-9543.

ELECTRONICS, Languages, more! U.S. Military courses. Free catalog. **FTP,** Box 1218P, GlenLake, MN 55345.

SATELLITE EQUIPMENT

VIDEOCYPHER II descrambling manual. Schematics, video and audio. Explains**DES, EPROM,** CloneMaster, Pay-per-view (HBO, Cinemax, Showtime, Adult, etc.) $16.95, $2.00 postage. Schematics for Videocypher Plus, $20.00. Schematics for Videocypher 032, $15.00. Collection of Software to copy and alter EPROM codes, $25.00. VCII Plus EPROM, binary and source code, $30.00. **CABLETRONICS,** Box 30502PE, Bethesda, MD 20824.

SATELLITE Radio Book and Guide. New book covers all audio services, SCPC, subcarriers, FM squared, facsimile, press services, weather services. Simple how-to-receive instructions. $16.95 plus $3.00 Priority Mail. **UNIVERSAL ELECTRONICS,** 4555 Groves Road, #12, Columbus, OH 43232. (614) 866-4605.

OBTAINING Sound for your VCII and VCII Plus is easy. No codes needed. Details: 1 (800) 211-5635.

DISH Network. America's top 40 channels for $19.99 a month. Units starting at $489.00 + $25.00 UPS. **OBUSZEWSKI ENTERPRISES,** 13253 Clute, Waterford, PA 16441.

COMPONENTS

RESISTORS 20 for $1.00. LEDS 4 for $1.00. Catalog $1.00. **ZIPFAST,** Box 12238, Lexington, KY 40581-2238.

CRYSTALS: 2Way/pager/scanner/microprocessor, delivery/performance guaranteed. Prototype/productions runs welcome. **VELCO ELECTRONICS,** (716) 924-2073.

SECURITY

ELECTRONIC sales of security systems for home, apartment, or business, will send information, call **(812) 295-4240.**

COMPUTER SOFTWARE

ZSORT. Sort huge files fast. Disk $5.00. Manual $10.00. Box 12238, Lexington, KY 40581-2238.

Trees Make a World of Difference™

Find out how trees can make a world of difference for you, and your neighborhood. For your free brochure write: Trees For America, The National Arbor Day Foundation, Nebraska City, NE 68410.

The National Arbor Day Foundation

CABLE TV CHANNELS
EQUIPMENT Direct!
GUARANTEED
FREE 30 DAY TRIAL
SAVE $1000's
The Nationwide source for cable TV equipment.
"BUY WHERE THE DEALERS BUY."
FREE
TV Cable Descramblers, Converterters and Magic Box Catalog. Open Every Day!
YOUR VCR TAPES CAN PLAY AS CLEAR AS DAY!
Eliminates copy protection on any tape.
UNJAM NOW WITH Video Decoder
• Copy any rental/bought tape
• Power Cord and RC Plugs Included
2 Year Warranty
CALL NOW!
Member Better Business Bureau
FREE 30 Day Trial!
MEGA ELECTRONICS
1-800-676-6342
VISA • MC • COD

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

MONEYMAKING OPPORTUNITIES

EARN $15,000 PER MONTH Collecting Judicial Judgments $$ Unlimited Income $$ 1-900-234-7575 Ext.7301, $1.99 Per Minute.

EARN EXTRA INCOME for Financial Security in just an Hour a Day! $7.00: B&B Innovations, Box 2897-(PE), Lake Placid, FL 33862.

OF INTEREST TO ALL

READ "HOW TO Handle Tough Times." Excellent Booklet Reveals Astonishing Secrets! Mail $1.00: Creative Power, Dept.PE, Post Office Box 1775, Mango, FL 33550.

SAVE BIG $$$ on cable TV rentals call 800-820-1727 Now! Major credit cards and COD's accepted.

E = MC²? $2.00: Quantum Enterprises, 3720 West Maunaloa, Phoenix, AZ 85023.

TELECOMMUNICATIONS HOME STUDY Course. S&C Communications, 52115 Ponderosa Way, Lapine, OR 97739.

NEW CREDIT FILE. For FREE Information Package Call: 215-953-0222.

GET YOUR OWN FREE PAGER! Features voice-mail and multi-message delivery and much more! 1-800-956-2846 #987608039.

CABLE CONVERTER DIAGNOSTIC TEST CHIP

LOAD FULL ACTIVATION OF CABLE CONVERTER

WE STOCK A COMPLETE LINE OF CHIPS,TOOLS, WIRELESS QUICK INSTALL TEST BOARDS AND DIAGNOSTIC CUBES FOR ALL CONVERTERS!

ANYONE IMPLYING ILLEGAL USE WILL BE DENIED SALE.WE SELL PRODUCTS ONLY!! TO TECHNICIANS OR CABLE REPAIR FACILITIES!!

#1 IN CUSTOMER SERVICE & TECH. SUPPORT!
***ALL ORDERS SHIP WITHIN 24HRS, UPS/ FED-X.**
***PRIORITY NEXT DAY SHIPPING AVAILABLE!**
***SALE= BUY 5 BOARDS GET 1 FREE TILL MAY96.**
***LOWEST PRICE & SUPERIOR PRODUCT GUAR!!**
***FRIENDLY COURTEOUS SERVICE. WE'RE PRO'S**

VISA MasterCard VISUAL

COMMUNICATIONS INC.
FOR ORDERS 1-800-GO-CABLE
CATALOG & TECH. SUPPORT 717-620-4363 EST. 1977

BUY BONDS

ADVERTISING INDEX

POPULAR ELECTRONICS magazine does not assume any responsibility for errors that may appear in the index below.

Free Information No.		Page
33	Ace Communications	88
—	AES	110
26	Alfa Electronics	84
28	All Electronics	101
—	Allison Technology	85
—	Allstar Electronics	93
39	AMC Sales	102
—	American Innovations	103
—	Andromeda Research	111
—	Basic Electrical Supply	105
30	Bel Merit	99
—	Black Feather	111
32	C&S Sales	106
—	Cable Discount	86
—	Circuit Specialists	94
—	Cleveland Inst. of Electronics	37
—	Command Productions	86
—	Computer Business Services	102
—	Comtrad Industries	CV3, 5, 28
—	Consumertronics	100
139	Dalbani	91
—	DC Electronics	90
137	Electronic Rainbow	80
—	Foley-Belsaw	109
—	Forest Electronics	88
—	Fotronic Corporation	81
—	General Device Instruments	108
—	Grantham College of Engineering	4
—	Greenleaf Electronics Inc.	110
—	Halcyon Group	105
—	Home Automation Systems	111
158	Home Controls Inc.	11
—	I.E.C.	104
—	Information Unlimited	103
13	Interactive Image Technologies	CV2
—	Intronics	112
—	KDE Electronics	103

Free Information No.		Page
—	Learn, Inc.	65
—	M&G Electronics	110
151	MCM Electronics	83
—	MD Electronics	87
—	Mega Electronics	113
48	Mendelson's	104
—	Mental Automation	85
157	MicroCode Engineering	3
—	Millennium Enterprises	112
—	Modern Electronics	102
138	Mouser	105
—	NESDA	50
—	NRI Schools	17
—	Ohio Automation	108
43	Optoelectronics	CV4
—	Orion Electronics	108
150	Parts Express	104
149	Phillips Tech	98
47	Prairie Digital Inc.	100
46	Print	85
45	Print	93
—	Protocol Electronics	104
—	Quality Entertainment	88
159	Radio Shack	7
—	Show Time	100
—	Silicon Valley Surplus	108
—	Skyvision Inc.	89
—	Tab Books	13, 53
—	TKA Electronics Inc.	82
136	UCANDO Videos	86
—	US Cyberlab	102
—	Vision Electronics	98
—	Visual Communications	113
—	Weeder Technologies	108
—	World College (Div. of C.I.E.)	9
—	WPT Publications	98
134	Xandi Electronics	97

ADVERTISING SALES OFFICE

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735-3931
1-(516) 293-3000
Fax 1-(516) 293-3115

Larry Steckler, EHF/CET
President (ext. 201)

Christina Estrada
Assistant to the President (ext. 209)

For Advertising ONLY
1-516-293-3000
Fax 1-516-293-3115

Larry Steckler
publisher

Arline Fishman
advertising director (ext. 206)

Michele Torrillo
advertising assistant (ext. 211)

Adria Coren
credit manager (ext. 208)

Subscription/
Customer Service/
Order Entry
1-800-827-0383
7:30 AM - 8:30 PM EST

ADVERTISING SALES OFFICES

EAST/SOUTHEAST

Stanley Levitan
Eastern Sales
1 Overlook Ave.
Great Neck, NY 11021-3750
1-516-487-9357, 1-516-293-3000
Fax 1-516-487-8402

MIDWEST/Texas/Arkansas/
Oklahoma, Colorado, Arizona

Ralph Bergen
Midwest Sales
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-847-559-0555
Fax 1-847-559-0562

PACIFIC COAST/Mountain States

Anita Bartman
Hutch Looney & Assoc., Inc.
6310 San Vicente Blvd.
Suite 360
Los Angeles, CA 90048-5426
1-213-931-3444 (ext. 227)
Fax 1-213-931-7309

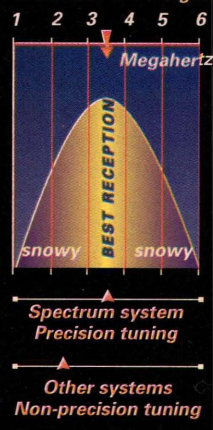
Fifteen years of microelectronic research makes conventional antennas a thing of the past!

This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better TV reception!

by David Evans

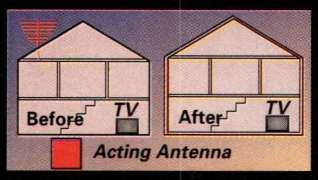
Technology corner

1. Why don't conventional antennas work as well as the Spectrum?



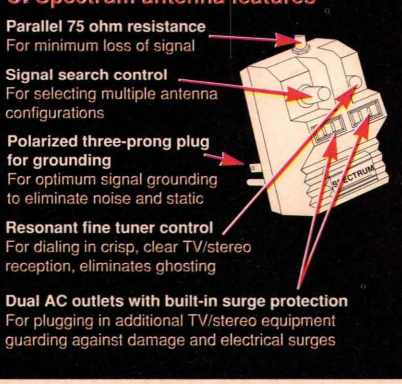
- When TV signals are tuned at the TV channel's center frequency, optimum tuning has been achieved.
- Other antennas can't offer center frequency tuning like the Spectrum Antenna can. They only offer such tuning up to the edge of the center frequency. As a result your TV picture remains snowy.

2. How does Spectrum use a home's electrical wiring as an antenna?



Believe it or not, the Spectrum Antenna simply "activates" the giant antenna that already exists in your home. Essentially, it uses all of the wiring throughout your home's walls and ceilings to make an antenna as large as your house for unbelievably clear reception of local broadcasting.

3. Spectrum antenna features


Parallel 75 ohm resistance
For minimum loss of signal
Signal search control
For selecting multiple antenna configurations
Polarized three-prong plug for grounding
For optimum signal grounding to eliminate noise and static
Resonant fine tuner control
For dialing in crisp, clear TV/stereo reception, eliminates ghosting
Dual AC outlets with built-in surge protection
For plugging in additional TV/stereo equipment guarding against damage and electrical surges

Until recently, the only convenient way to guarantee great TV reception was to have cable installed or place an antenna on top of your TV. But who wants to pay a monthly cable fee just to get clear reception, or have rabbit-ear antennas that just don't work on all stations? Some people just aren't interested in subscribing to cable. Or they may live in an area where they can't get cable and TV-top antennas aren't powerful enough. And what about those people who have cable or satellite systems but still can't get certain local stations in clearly?

Now, thanks to fifteen years of microelectronics research, a new device has been developed that is so advanced, it actually makes conventional antennas a thing of the past. It's called the Spectrum Universal Antenna/Tuner.

Advanced technology. Just imagine watching TV and seeing a picture so clear that you'd almost swear you were there live. Just plug the Spectrum Antenna into a standard AC outlet and plug your TV into the Spectrum. You can remove the unsightly clutter of traditional TV-top devices gathering more dust than television signals. Get ready for great reception. Your TV will suddenly display a sharp, focused picture thanks to its advanced design "Signal Search" and "Fine Tuner" controls.

Uses your home's electrical wiring. The Spectrum Antenna is a highly sophisticated electronic device that connects into a standard wall outlet. The outlet interfaces the Spectrum Antenna with the huge antenna that is your home wiring network. It takes the electrical wiring in your house or apartment and turns it into a multi-tunable, giant TV reception station which will improve your TV's overall tuning capability. The results are incredible. Just think how much power runs through your home's AC wiring system—all that power will be used to receive your local broadcasting signals.

How it works. Broadcast TV signals are sent out from the local broadcast station (ABC, CBS, NBC, etc.). They interface with your home's AC power line system, a huge aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna interfaces with the AC line, the signal is sent to its signal processing circuit. It then processes and separates the signal into 12 of the best antenna configurations. These specially processed signals route themselves into 12 separate circuits. The Spectrum Antenna includes a 12-position rotary tapping switch, the "Signal Switch" control, which gathers twelve of the best antenna configurations.

The "Signal Search" offers varying antenna configurations for the user to select from the best signals of all those being sent. The signal then passes through the Spectrum Antenna's special "Fine Tuner" circuit for producing crisp, clear reception.

Risk-free offer. The Spectrum Universal Antenna/Tuner comes with our exclusive 90-day risk-free home trial and a 90-day manufacturer's warranty. Try it, and if you're not satisfied, return it for a full "No Questions Asked" refund.

Who can use Spectrum?

- ***Cable users*-You have cable but you can't get certain local stations in clearly.**
- ***Non-cable users*-You don't have cable and want the stations to come in more clearly**
- ***Satellite users*-You have a digital satellite system but can't get local stations in clearly**

Limited time offer! We realize that most people have more than one TV in their home. We are offering a special discount on additional Spectrum Antennas so you get great reception on all your TVs!

Spectrum Antenna™.....$39 $4 S&H

Additional antennas just.....$34 S&H free

Please mention promotional code 1492-PL-6665.

For fastest service, call toll-free 24 hours day

800-992-2966

COMTRAD INDUSTRIES
2820 Waterford Lake Drive, Suite 106
Midlothian, Virginia 23113

Capture the action!

Don't Miss Out!!!
Purchase a Scout for only $449.00 & Receive Free:
- DB32 Mini Antenna
- CC30 Carry Case
- Spectrum FCC CD

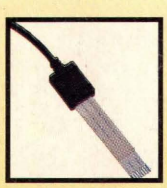
Total package value $526.00
For only $449.00
LIMITED TIME ONLY!!

$449

Scout® Reaction Tune® brings you all the action. Whether it is police, fire, commercial or just everyday communications monitoring, the Scout will bring you closer to the action. The Scout will not only capture the frequency, but it automatically tunes the receiver to that frequency at the same time; (*see receivers appl. below*). Let the Scout Reaction Tune your way into the world of communications.

FEATURES

- Records up to 400 unique frequencies in memory.
- Records up to 255 hits on each frequency in memory.
- 10MHz - 1.4GHz single frequency range.
- Records frequencies automatically with Patented Digital Auto Filter & Digital Auto Capture.
- Reaction Tune the AOR AR8000, AR2700, ICOM R7000, R7100, R9000, Radio Shack Pro 2005/2006 with OS456 installed, and the Radio Shack Pro 2035/2042 with OS535 installed.
- All frequencies are automatically saved until deleted.
- Interface to a PC with the optional ***OPTOLINX*** or ***CX12AR*** for data download.
- Custom 10 digit LCD display with automatic EL backlighting.
- 16 segment RF signal strength bargraph.
- Pager style vibrator for discreet recording. Distinctive beeper indicates frequency detection.
- Rapid charge NiCads with AC charger supplied; 2 hour recharge and 8-10 hour battery discharge.



SAC8000 $35

•Using the optional SAC8000 is a snap-Just plug and play. SAC8000 includes cable, back panel with slot, and velcro attachments.

SPECS

Frequency Range: 10MHz - 1.4GHz
Input Amplifier: 50 Ohm vswr <2:1
Sensitivity: 1mV 30MHz - 900MHz
Maximum Input: +15dBM, 50 milliwatts
Display: 10 digit LCD with backlight

Operating Time: 8 - 10 hours
Power: 2VDC 1 Amp wall plug adapter for rapid charging. 6VDC 130mA minimum operating power required. AC90 adapter supplied.

Factory Direct Order Line: 1-800-327-5912

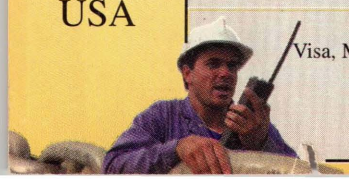
MADE IN USA

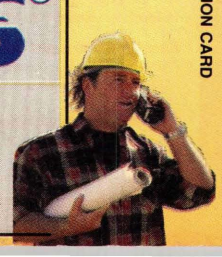
OPTOELECTRONICS®

5821 NE 14th Avenue • Ft. Lauderdale, FL 33334

Visa, MasterCard, C.O.D. Prices and Specifications are subject to change without notice or obligation
All specials are subject to change without notice or obligation.

Internet: http://www.optoelectronics.com
Tel: 954•771•2050 Fax: 954•771•2052





CIRCLE 43 ON FREE INFORMATION CARD